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QUARTERLY

OF THE

National Fire Protection Association

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87 MILK STREET, BOSTON, MASS.

National Fire Protection Association.

(INTERNATIONAL.)

Executive Office, 87 Milk Street, Boston, Mass., U. S. A.

July, 1920.

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American Institute of Consulting Engineers.
American Institute of Electrical Engineers.
American Ceramic Society.
American Concrete Institute.
American Electric Railway Association.
American Gas Association.
American Petroleum Institute.
Arkansas Fire Prevention Bureau.
Associated Factory Mutual Fire Insurance Co's. Inspection Bureau.
Associated Manufacturers of Electrical Supplies.
Associated Metal Lath Manufacturers.
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Association of the Fire Alarm Industry.
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National Association of Credit Men.
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National Association of Electrical Inspectors.
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National Association of Roofing Contractors.
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Underwriters' Association of the Middle Department.
Underwriters' Association of New York State.
Underwriters' Bureau of Middle and Southern States.
Underwriters' Bureau of New England.
Underwriters' Laboratories.
Underwriters' Service Association.
Vancouver Island Fire Underwriters' Association.
Washington Surveying and Rating Bureau.
Water Works Manufacturers' Association.
Western Actuarial Bureau (Fire).
Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Photo by Association of the Motion Picture Industry.

FILM EXCHANGE BUILDING,

Seventeenth and Main Streets, Kansas City, Mo.

This is the first building to be erected in the United States exclusively for the purpose of housing film exchanges. The building was constructed to meet the N. F. P. A. specifications for the storage and handling of nitro-cellulose motion picture film.

The Quarterly

Vol. 14 **July, 1920** **No. 1**

The Twenty-Fourth Annual Meeting.

The *Proceedings* of the Chicago meeting, already distributed to members, indicate a larger registration than at any previous convention of the Association. At certain hours the attractive meeting room in the Insurance Exchange was overcrowded. A further growth in our membership will force us into larger quarters for our next Chicago meeting. This will combine matter for congratulation with matter for regret, for we have been very comfortable in the years past under the hospitable wing of our member, the Chicago Board of Underwriters. Besides other attractive features, the room is used for speaking, and most meeting rooms, especially hotel rooms, are not.

There was not a dissenting voice to the adoption of the report of the Committee on Articles of Association recommending an increase in the amount of membership dues. The matter was not even discussed. The members accepted at their full value the statements of the Executives that the increase was necessary, those who are members of other organizations realizing that the dues of the N. F. P. A. have for a number of years been too low, and those who have not such a basis for comparison agreeing that the Association should no longer be crippled for funds in the conduct of its important work.

The high light of the meeting, so far as dramatic interest was concerned, was not the important matter of finance, but the attack upon the report of the Committee on Signaling Systems by the representatives of a member whose official representative on the Committee had voted in favor of the report. The members listened attentively to the arguments against the unanimous recommendation of the Committee, but were not swayed by them, and the leader of the opposition contributed the final word by gracefully moving the adoption of the report. It is not the first time in the Association's history that a difficult situation has been retrieved by good nature.

None of the other committee reports encountered organized opposition, although Professor Woolson, in presenting the report of the dying Committee on Nomenclature, reached an altitude of resignation at which he was perfectly willing to define a fire wall as a three-legged white horse with a howdah as a parapet if the members insisted on it. After chasing this committee for four years through the swamp of specifications in

which it was never intended it should set its foot, the Association raised as a monument over its dead body the definition of a fire wall it had presented in its first report.

* * * * *

The Elusiveness of Nomenclature. The Committee on Nomenclature, which the Association put out of its misery at Chicago, was created in a moment of ecstasy on the initiative of a few envisioned enthusiasts who believed that the members of the N. F. P. A. could be trained to call the same thing by the same name for two successive meetings. The twenty years' fruitless struggle of the editor with the old committeemen to induce them to substitute "shall" or "must" for "to be"; and the annual exhortations of Mr. A. R. Small that we use the term "fire-resistive" for "fireproof," should have taught those adventurers in orismology the futility of their undertaking. Beside the dyed-in-the-wool perverseness of as argumentative a group of human beings as the Lord ever assembled in one organization, our late lamented Committee encountered a generic obstacle to its success in the nature of language itself. If it couldn't establish a stable definition of "fire-wall" for two years in succession in a group which presumably knows perfectly well what a fire-wall is, what chance had it in attempting definitions of less opaque objects? Language is fluid, that's the fact; and as we grow in ideas we create it. Even more tractable individuals than the members of the N. F. P. A. love to make adventure in nomenclature. Weber and Fields made a theatrical success of it.

Some discussion has occurred recently in London on the subject of "pure English," the occasion of which was the publication of a book on *English Homophones* by the poet laureate. What is pure English? And supposing this were discovered, would the Americans desire to use it? When language is conventionally used by writers it becomes burdened with dead phrases. If American newspapers are any evidence, it is clear that the American people is evolving a new language full of vigorous if not refined expressions. Continental literary men are not blind to this. In a recent issue of *Les Marges*, a French literary fortnightly, a writer on poetry (M. Jean Catel) declares his conviction that within a reasonable time a new, vigorous language will be developed in America as the medium of expression for its literature. Are its beginnings not discernible at our annual meetings?

* * * * *

Has a Fire Wall a Parapet? The blue-pencil slashing of eight or ten pages of the official stenographer's report of the annual meeting which had to do with the discussion of a parapet on a fire wall during the presentation of the report of the Committee on Nomenclature did not finally settle the controversy. The members who were not permitted by the chairman to continue this discussion out of order from the floor took the train for their homes and began writing about it. But Professor Woolson has disposed of his adversaries. While the quoting of scripture by anyone from New York may be received with certain sly, derisive smirks in regions like St. Louis

and Chicago, those cities are not yet so abandoned as to flout the scriptural injunction itself. Besides, in this particular instance the cry from Macedonia was answered by New Jersey. Professor Woolson writes as follows:

Referring to the definition of a *Fire Wall* as discussed at rather unreasonable length in recent N. F. P. A. meetings, I trust it has at last been established on a firm foundation so that it will withstand attacks of both fire and criticism.

You will remember that during the discussion the question was raised as to the necessity for a parapet on all such walls, and various reasons were given justifying this requirement. Among these was mentioned the fact that firemen strongly favored such parapets as a breastwork behind which they could advantageously fight a fire coming through the roof of an adjoining building. Also that a parapet served to protect firemen from falling off a roof when groping their way about in darkness or thick smoke.

In talking about this recently to my Committee member, Mr. Robert Palm, of New Jersey, he said the requirement of a parapet was as old as "the Laws of the Medes and Persians," and referred me to Deuteronomy, Chapter xxii., Verse 8, which reads as follows:

> "When thou buildest a new house, then thou shalt make a battlement for thy roof, that thou bring not blood upon thine house if any man fall from thence."

As the necessity for a parapet is, therefore, well established by Biblical law, it would appear that the top of our fire wall is well anchored and the whole structure ought to stay put.

In the absence of any further reports from the Committee on Nomenclature we do not see how the members can possibly revive this discussion at a future meeting unless Professor Woolson should sometime unguardedly refer to a fire wall in presenting the subject of building construction.

* * * * *

Frost-proof Cabinets for Chemical Fire Extinguishers.

The report of the Committee on *Field Practice,* dealing principally this year with first aid devices, called out the usual references to frost-proof cabinets for the soda-and-acid chemical. It will be remembered that two or three years ago this committee suggested some experiments by Underwriters' Laboratories to determine the possible effectiveness of such heat insulation. Engineer E. J. Smith reports such experiments, but says he was not able to go thoroughly enough into the matter to secure results wholly conclusive. His feeling, however, is that cabinets without a heating unit are not to be depended on for protection.

In the winter of 1918-19, three cabinets were made up with cork, mineral wool and cow hair as the insulating materials. Concerning this experiment Mr. Smith writes:

It unfortunately happened that at the time these cabinets were completed we did not have any very low temperature conditions, and the results obtained were not entirely positive. They were of such a nature, however, as to indicate that the insulating effect of the cabinet as constructed was not sufficient to give assurance that extinguishers installed in these cabinets and subjected to sustained low temperatures would not be damaged or rendered inoperative in a comparatively short time.

To give an idea of the results obtained which led to the above conclusion, the following will be of interest:

Three extinguishers filled with 2½ gallons of water were placed in the cabinets with the water temperature and the temperature of the interior of the cabinets at about 70° F.; the cabinets were closed tightly and removed to the outside of the building, where they were subjected to a temperature around freezing; our

records during the day indicating the temperature 28 to 34° F., and Weather Bureau reports indicating temperatures of 27 to 30° during the night. After standing for 42 hours, the cabinets were opened and the temperature of the water in the extinguisher determined with the following results:

The water in the cabinet insulated with mineral wool was found to have a temperature of 41° F., and the water in the cork and cow-hair insulated cabinets about 43° F.

The tests were then repeated for a longer period of time. Starting with the water temperature at about 80° F., and allowing the cabinets to stand outdoors for a period of one week, during which time the temperature varied from 32° F. to 45° F., at the end of the week the temperature of the water was found to be 44° F.

We propose to make further tests during the coming winter, not only with the above cabinets, but also with cabinets provided with different and with heavier insulating material, but are inclined to recommend that until an absolutely reliable frost-proof cabinet has been developed, it might be well to adopt the practice, which we understand has been followed in some territories, of providing an electrical heating element, such as an incandescent lamp, for each cabinet.

During the winter of 1919-20, these tests were continued, still with negative results. Commenting upon these further experiments, Mr. Smith in a second letter says:

We have not as yet assembled the data obtained, but may say that we found that extinguishers introduced into well-constructed cabinets provided with different insulation material, such as cow's hair, cork, etc., indicated an interior temperature drop from 70° F. to practically the freezing point of the liquid, with outside temperatures quite a little above Zero F.

On account of being shorthanded we were not able to construct frost-proof cabinets of the heated type in order to determine the size of heating element necessary for different temperatures, but judging from reported experience by others in the past we have no doubt but that, where electric current is available, comparatively cheap cabinets provided with an electric light may be depended upon to maintain the extinguisher at a proper operating temperature in practically all conditions met in the field.

We had expected to be able to have constructed a frost-proof cabinet made on the Thermos bottle principle. On account of the manufacturer failing to respond, this has not been done, but observation of the efficiency of even as well constructed a device as a Thermos bottle leads us to believe that a cabinet even of this character could not be depended upon for any reasonable length of time.

* * * * *

Mixing Up the Chemicals.

We have all heard, probably, of the owner of a stock of unsalable goods filling his one-quart extinguishers with gasoline in preparation for an unfortunate emergency he hoped for; but ignorance as well as design may cause an extinguisher to fail to perform its proper function. Supervisor A. B. Sloan of the Factory Insurance Association writes:

One of our inspectors recently had an experience with one of the two and one-half gallon soda and acid chemical extinguishers which brings out the ever-present hazard of the human element which we have to deal with daily.

A fire was reported in a gasoline engine in a building near the mill where our inspector was working. In running to the fire the men carried with them the two and one-half gallon chemical extinguisher, but upon inverting it in an endeavor to play the same upon the gasoline fire it was found that the extinguisher was inoperative, no pressure at all being developed.

After the fire was extinguished by means of two one-quart carbon tetrachloride extinguishers, an investigation was made of the extinguisher which had failed. This revealed that it had been charged at the time of refilling with sulphuric acid and carbon tetrachloride solution. Unfortunately, as is usually the case under such circumstances, our inspector was unable to ascertain why this solution was used in filling this type of extinguisher. It is assumed, however, that this was done through

ignorance, the party doing the refilling undoubtedly considering that if the carbon tetrachloride solution were used with the acid a far more effective extinguishing agent would be provided.

In the old days when the soda-and-acid extinguisher had the field to itself such experiments were unlikely. All chemical solutions are, however, alike to the ignorant, and blunders of the sort related by Mr. Sloan must be expected if persons unfamiliar with the various charging liquids and their properties are given the responsibility of maintaining these first aid devices.

* * * * *

A Member Scores a Hit.

Our member Walter F. Smith of Trenton, New Jersey, whose interest in his business of fire insurance is not confined wholly to the premiums on the policies he issues, made an examination nearly three years ago of the State Normal and Model Schools in Trenton to see if a member of the N. F. P. A. couldn't contribute something to the safety of his own city. As a result of this examination Mr. Smith wrote the authorities on November 3, 1917, as follows:

> In the model wing there is a small room about 12 feet by 15 feet in the basement, where waste paper is dumped from the floor above and allowed to accumulate until baled. As there are steam pipes in this room with which this waste paper comes in contact, it constitutes an unnecessary hazard, and I would recommend that automatic sprinklers be installed therein so that any fire originating here would be immediately controlled thereby. The trap door through which the paper is thrown from the floor above should be repaired and made self-closing as intended.
>
> Near the Manual Training Department there is a shavings vault about 10 feet by 12 feet, which in my judgment should be similarly equipped. If the Board of Education concur in these recommendations I shall be very glad to lay out the installation so that it can be installed by any ordinary mechanic.

These recommendations were complied with and ten automatic sprinkler heads were installed. On April 15, 1920, the watchman discovered smoke in the building, but could not locate any fire. He turned in the alarm to fire department headquarters. Upon the arrival of the firemen it was found that a fire had occurred in the waste paper room in the basement of the model wing, which had been extinguished by the operation of two sprinklers with no damage to the building or contents.

There isn't much to say about this that will make Mr. Smith feel any better than he already does over the fine result of his thoughtful service to Trenton; but it may be a fair question for each of our members to ask himself if he has done as much for his own city. The fate of any school building anywhere may depend in a fire tonight upon just such a quiet, unostentatious service as that of Mr. Smith—rendered three years ago as his was, or today as ours might be.

* * * * *

Fire Prevention Instruction in New Jersey Schools.

It may seem a bit invidious to pick out at this moment another citizen of the same city of Trenton for individual complimentary reference, but New Jersey has no monopoly of opportunities for service nor of members of the Association capable of rendering it. Our member George B. LaBarre is Trenton's Director of Public Safety; and although a frequent correspondent of the N. F. P. A. office we had first

to learn through another enthusiastic member, Knickerbacker Boyd, of Philadelphia, of Mr. LaBarre's recent special service to fire prevention education in his state.

When the matter of teaching fire prevention in the schools came up, Mr. LaBarre at once identified himself with the effort to secure state legislation to that end. There have come to us from other sources than his own office copies of letters written by him to New Jersey assemblymen urging this legislation with forcible illustrations and convincing argument. The bill was introduced in the Assembly on March 1st, and in a little over a month was enacted into law to become operative in the schools next Fall. A copy of the measure is here given:

ASSEMBLY, No. 366—STATE OF NEW JERSEY.

AN ACT TO COMPEL INSTRUCTION IN THE PUBLIC, PRIVATE AND PAROCHIAL SCHOOLS OF THIS STATE IN FIRE PREVENTION AND SAFEGUARDING LIVES AND PROPERTY AGAINST LOSS BY FIRE.

BE IT ENACTED by the Senate and General Assembly of the State of New Jersey:

COURSE OF STUDY IN FIRE PREVENTION.

1. The Commissioner of Banking and Insurance and the Commissioner of Education are hereby empowered and directed jointly to provide a course of study in fire prevention for use in the public, private and parochial schools of this State dealing with the protection of lives and property against loss or damage as a result of preventable fire.

ARRANGEMENTS OF INSTRUCTION.

2. It shall be the duty of the board of education, school directors, trustees or other committees or persons having control of the public, private or parochial schools in each township, village, borough or city or school district thereof to arrange for said course of study in fire prevention and to compel its use in each school under its or their control or direction.

EXTENT OF TIME FOR INSTRUCTION.

3. On and after September first, one thousand nine hundred and twenty, it shall be the duty of each teacher in any public, private or parochial school of the State of New Jersey to devote not less than one hour in each month, during which such school is in session, to the instruction of the pupils thereof in said course of study in fire prevention comprising the ways and means of preventing loss and damage to lives and property through preventable fires.

4. This act shall take effect immediately.

Approved April 7, 1920.

This act seems to us admirably to cover the matter. No class of school is omitted in city or country, and the one-hour minimum for instruction in this subject is so reasonable as to impose no onerous burden upon the teachers where they themselves must undertake the actual instruction.

* * * * *

The Uniformed Fireman as a Teacher

It has always been the thought of the present Secretary of the N. F. P. A. that this instruction of public school pupils in fire prevention should be administered by uniformed firemen, except in such districts as cannot provide trained firemen to perform the service. The school teacher can study her text book and communicate a great deal; but the fireman can add the contribution of his own experience. His

coming once a month will make the prospective hour one of unusual interest to the pupils. The element of dramatic interest will be contributed by the presence of the man in uniform whom the children may see at other times rolling to a fire on a ladder truck or engine. The pupils may be assembled in the school auditorium for this instruction, the whole job being done at once, and the hour's wear and tear on eight or ten individual teachers trained for other tasks thus saved.

Besides all this, it is a logical part of the fire department's service; for the fire department is coming more and more to consider fire prevention as important as fire extinguishment. Boston's fire department may be the first to furnish regular teaching service of the sort indicated. The N. F. P. A. Boston cabinet, of which Fire Commissioner John R. Murphy is the head, has discussed this plan and the Commissioner has approved of it. A conference is to be arranged with the Commissioners of Education for the purpose of considering the feasibility of putting this service into operation, beginning with the next school year. Such instruction is not legally compulsory in Massachusetts; but where the Fire Commissioner and the Commissioners of Education agree it is desirable, no law on the subject is needed.

* * * * *

The Gun Cotton Film in Seattle.

One of the first things a practical uniformed fireman might do would be to warn the pupils to see that their teachers, preachers and parents do not expose them to fire, panic and possible death by the use of the nitro-cellulose motion picture film without the protecting booth. The burning of such a film in the crowded assembly room of the Hawthorne School in Seattle in May is a case in point.

A 1000-foot reel of nitro-cellulose film was being shown in a "De Vry" projector. The automatic shutter over the aperture stuck in an open position, exposing the stationary film to the rays from the lamp, causing the film to take fire. This make of machine has no separate metal compartments for the supply and take-up, therefore the full 1,000 feet of film was exposed and immediately affected when that portion in the machine head became ignited. The minister of a nearby church who was displaying the film pluckily rushed through the room with the blazing machine and threw it outside the building. The children were terror-stricken. With the first flash of fire the rush toward the door started. It was the pupils of the first four grades, the smallest in the school, who were being shown the film. Older pupils might not have been calmed so easily. Miss Bella Perry, principal, was in the doorway, and after four children had all but knocked her down succeeded in stopping the rush in that direction. The other teachers by their example and with scarcely raised voices succeeded in quieting the frightened youngsters.

Meanwhile in other rooms of the school the sound of the screaming children and the smell of the burning film had reached the pupils. In the eighth grade room of Miss Anna Wernett, one girl jumped to her feet crying fire. Though somewhat frightened herself, Miss Wernett pointed a finger at the girl and in a stern voice said:

"Have you heard any fire bell?"

"No," weakly admitted the girl, dropping back into her seat.

"Well, then, there is no fire," answered Miss Wernett, and after waiting a moment for the whole room to get the situation, she proceeded to satisfy herself that she had given the right answer.

Inspector John Reid of the Seattle Fire Department in a report furnished Seattle Chapter, N. F. P. A., comments as follows:

The "De Vry" projector is a small type of motion picture machine somewhat similar to others of numerous makes now on the market. The machine head and small driving motor, projection lamp and film are all contained within a sheet-metal cabinet, lined on the inside with asbestos paper and on the outside with imitation leather. The right side is hinged to open out, for the purpose of threading the machine, etc. A suitcase handle permits the cabinet to be carried easily from place to place, the whole resembling a drummer's sample case. When it is to be operated it is placed upon a table in the center of an ordinary sized assembly room; therefore, the audience is seated on all sides of it. The projection light is obtained by connecting with a drop cord, and a 400-watt lamp is used. The fire demonstrated that the rays from a 400-watt lamp will ignite a film. Agents for machines using that size lamp have claimed it would not, and have given us a great deal of trouble in advertising them as being safe from fire, in telling prospective purchasers that they therefore need not provide a protecting booth, and in endeavoring to obtain an amendment to our safety laws which would permit their use in assembly rooms without a portable booth. They succeeded in getting such an amendment passed in Spokane.

Another machine which has been lately placed on the market, aside from using a 1000-watt lamp, which is hot enough to ignite the film within three seconds, is supplied with two thick pads of felt, 2 by 1½ inches, and just enough apart to allow the film to pass between—one pair above the film gate and another below. The object of these pads is to steady the film as it passes the aperture. These are liable to exert undue pressure on the film, and to become gummed as a result of receiving grease and dirt from the film as it passes between, thereby stopping it before the aperture, where it is exposed to the heat from the light.

It is certain that this inflammable film would not have been used had either the school authorities or the owners of it been aware of its gun cotton quality. It was a picture designed to illustrate home gardening. It had been made for the Seattle Chamber of Commerce by a local photographer, Jacobs, and given to the School Board, who in turn loaned it to the Parent Teachers' Association, to be shown in the assembly room in the above school.

* * * * *

The Gun Cotton Film in New Orleans. In New Orleans in May it was one of the "toy" machines, so called, with sprockets arranged to take the professional film, that furnished the menace. Here, too, good fortune prevented loss of life. The machine was a "Keystone Movigraph," made in Boston, Mass., and said to have been purchased from the Maison Blanche, a department store of New Orleans, at a retail price of about $5.00. The film used with this machine is sold in any quantities desired, usually five or ten feet at a time, but even such a small piece of film will start a considerable fire.

Chief Electrical Inspector Geo. Welman of the Louisiana Fire Prevention Bureau, in reporting the fire, says:

A lad about 14 years of age was the owner of this toy machine, and had acquired enough pieces of film from the refuse of various film exchanges to build up about 10,000 feet of assorted film, wound on ten standard sized reels. This stock was kept in the attic of the large frame, two-story dwelling, at 1421 Napoleon

Avenue for amusement of playmates. The attic was lighted with one electric light, the globe of which had burned out, and a lighted candle was used as a substitute. After lighting the candle, the match was thrown into the pile of films, and a serious fire was the immediate result. The nearest fire station is located across the street, and this probably saved the house from complete destruction. The attic was badly burned. The loss to the building and contents will amount to several thousand dollars. We can imagine the holocaust that could have resulted had the attic been filled with children when this fire occurred, but fortunately the one child in the attic had been called to the stairway before the fire started, and no one was injured.

The sale of toy or other miniature machines equipped with sprockets or apertures with which professional films can be used should be prohibited by law. As far back as 1913, this Bureau notified department stores in the city of New Orleans of the toy picture machine and nitro-cellulose film hazard, but as long as there is no law regulating the sale of such devices there is small hope of any persuasive effort on our part securing results. Film exchanges should be required to dispose of their rubbish by destroying all scrap film.

The possibilities suggested by Mr. Welman are not overstated. It may be considered the merest chance that the attic was not full of the neighborhood children at the time of the fire. Some day, any day, the fatal combination of a company of children and a gun-cotton motion picture film will be made. And then we shall see the man who furnished the film and the man who furnished the machine to exhibit it (without the protection they both know is necessary for safety) pointing at one another in an effort to escape their common culpability.

* * * * *

Judgment Fixes Fire Responsibility. An important decision, fixing the responsibility of electric light and power companies for fires caused by faulty installation and operation, has been rendered by the Lords of the Privy Council at London in an appeal carried up from Quebec. Several houses were burned near Quebec by the contact of the high tension with the low pressure wires of the Quebec Railway, Light, Heat and Power Company, sending the full current into the dwellings equipped with the low tension wires and causing a loss of $60,000. The electrical committee of the Canadian Fire Underwriters' Association had investigated its losses due to the Quebec company, and its chief electrical inspector had reported after a careful investigation that the faulty distribution system was responsible for most of these fires. Recommendations were made to the electric company of the changes necessary to remedy the defects, but nothing was done, and the serious fires of December, 1912, led the insurance companies to pay the losses and begin suit against the electric company. The lower court found the electric company responsible and gave judgment for $60,000, plus interest and costs. After several appeals, the Supreme Court of Canada affirmed the judgment, but gave consent to the electric company to appeal to the Privy Council at London, which has upheld the earlier judgment.

Meeting of Executive Committee.

The usual meeting of the executives following the annual meeting of the Association was held in New York City on June 18th for consideration of matters referred to the Committee by the Association, for revising the rosters of the various committees where necessary, and for consideration of reports, finances, communications, etc. The following members were present:

Rudolph P. Miller, Chairman, New York.
D. Knickerbacker Boyd, Philadelphia.
J. H. Brumbaugh, Chicago.
Gorham Dana, Boston.
W. A. Hull, Washington.
J. H. Kenney, Baltimore.
H. L. Miner, Wilmington, Del.
Benjamin Richards, Chicago.
W. O. Robb, New York.
E. L. Sanders, Worcester.
Robert Scott, Wilmington, N. C.
A. R. Small, Chicago.
W. E. Mallalieu, New York, President.
H. O. Lacount, Boston, Vice-President.
F. J. T. Stewart, New York, Past President.
Louis Wiederhold, Jr., Philadelphia, Past President.
Franklin H. Wentworth, Boston, Secretary-Treasurer.

Dana Pierce, New York, Chairman of Electrical Committee, and I. H. Woolson, New York, Chairman of Committee on Building Construction, were present by invitation.

It was *voted* to hold the 25th annual meeting on June 7, 8, 9, 1921, in *San Francisco,* and the Secretary was requested to address the organization members bespeaking their early consideration of the matter of adequate representation at this meeting.

The President, Secretary and Chairman of Executive Committee were appointed a *Program Committee,* with permission to add other members.

Members Walter A. Hull and Robert Scott were elected to complete the Nominating Committee, 1921.

It was *voted* to accept the invitation of the American Engineering Standards Committee to the Association to act as sponsor for the *Safety Code on Stairways, Fire Escapes and Other Exits,* and to request the N. F. P. A. Committee on Safety to Life to prepare and present such a code to the Association for consideration, adoption and registration with the American Engineering Standards Committee.

It was *voted* to accept the invitation of the American Engineering Standards Committee to the Association to act as joint sponsor with the Bureau of Standards U. S. for an *Electrical Fire and Safety Code,* and to so advise the Electrical Committee of the N. F. P. A., it being understood that the acceptance of such joint sponsorship for such code does not commit the N. F. P. A. to discontinuance of the National Electrical Code (Fire).

It was *voted* to submit the National Electrical Code (Fire) as of 1920 to the American Engineering Standards Committee for registration.

The matter of reconsideration of the present form of representation of the *Fire Group* in the American Engineering Standards Committee was discussed and laid upon the table.

The Secretary was requested to advise New York Chapter N. F. P. A. that its suggested plan for local membership in the Chapter by persons not members of the Association was not considered advisable.

The Association's present practice of the attempted promotion of the observance of a joint "Fire and Accident Prevention Day" was discussed in connection with a letter from the Secretary of the National Safety Council to the Secretary of the N. F. P. A., and it was *voted* the opinion of the Committee that both accident and fire prevention propaganda would benefit by the adoption of different dates or periods for these special educational efforts.

It was *voted* to adopt Saturday, October 9, 1920, as *Fire Prevention Day*, and to request the N. F. P. A. Committee on that subject to endeavor to make its observance as general as possible in the United States and Canada.

The President, the Chairman of the Committee on Public Information, and the Chairman of the Sub-Committee on Motion Picture Films were appointed a committee to confer with federal authorities at Washington in an effort to secure the printing of educational motion picture films issued by government departments or bureaus upon slow-burning stock.

Consideration of the following resolution adopted by the Association at its seventh annual meeting, Chicago, 1903, was requested by an organization member:

WHEREAS, it has been the practice of the automatic sprinkler companies to sell sprinklers to be installed by others, and as this practice is growing to the detriment of reliable and satisfactory automatic sprinkler installation; and

WHEREAS, our members have experienced much difficulty in having equipments properly installed, under such conditions, in accordance with our rules; be it

RESOLVED: That it is the sentiment of the National Fire Prevention Association that automatic sprinklers should be installed by the recognized automatic sprinkler companies, and should not be sold to be erected by those not experienced in the installation of an automatic sprinkler equipment, unless such installation be guaranteed to comply with the rules of the National Board of Fire Underwriters by the sprinkler company furnishing the devices installed.

It was *voted* as the sense of the Committee that the position taken in this resolution is no longer necessary, and the Secretary was directed to request the Committee on Automatic Sprinklers to consider a report to the Association on the matter.

The matter of the connection of automatic sprinkler systems to special fire service water mains was discussed, and the Secretary was advised to request the Committee on Private Fire Supplies to Public Mains to present to the Association proposed regulations on this subject.

The Committee on *Automatic Sprinklers* reported for approval the following action on items referred by the annual meeting:

Rule 27. No change from report as presented.
Rule 51. No change from report as presented.
Rule 53. Change "The supply for the sprinkler protection in the dry pipe valve enclosure *shall be"* etc., to, *"should preferably be,"* etc.
Rule 59. (Public Water.) Substitute "standard" for "as acceptable," so that the sentence will read: "The supply from city main should not be considered *standard* unless a hydrant test," etc.
Rule 67. Change first paragraph to read: *"To equipments having a single riser, attach on the system side of the gate valve in the riser for a wet system, but between the dry valve and the gate valve for a dry system."*

The above action was approved, and it was *voted* to recommend the promulgation of the revised regulations as of 1920.

The Committee on *Signaling Systems* reported for approval the following action on items referred by the annual meeting:

Rule 14, *g.* (Second line): Substitute "5 to 12-foot bays" for "6 to 12-foot bays." (Fifth line): Substitute "5 to 8-foot bays" for "6 to 8-foot bays."
Rule 21, *b.* (Third line): Change "4 inches below or above" to *"3 inches."*

The above action was approved, and it was *voted* to recommend the promulgation of the revised regulations as of 1920.

The Committee on *Fire Pumps* reported for approval the following action on items referred by the annual meeting:

Centrifugal Fire Pump Specifications.

Paragraph 43. Print in bold face type the first introductory paragraphs as revised.

Paragraph 43, *f.* Objection has been raised as to this requirement. It refers, however, only to curve BB—a comparatively flat curve and one that can readily be produced. As several manufacturers are able, without hardship, to meet this point, no change in this article is recommended.

Amend 3rd Paragraph of 55, *b to read*: Unless provision is made in the installation for a hose valve header away from pump, the hose valves required by Art. 57*a* must be connected to this discharge casting at a high enough level to safeguard priming water. Opening must be provided in this casting as per following table for hose valves, relief valve, air and starting valve and priming connection.

Insert New Paragraph in Art. 66. *b.* For pumps driven by constant speed motors and taking water under a variable pressure head, a second valve must be installed between the pump casing and the discharge casting.

This valve under the conditions mentioned will enable the operator to control the resultant pressure which otherwise follows the natural characteristic of pump. An angle globe valve of substantial construction inserted in place of the lower elbow will best serve this purpose.

Add New Paragraph to Art. 74. *e.* Bearing shells and caps for motors must be of the split type to permit of removal and replacement without disturbing the motor or shaft after installment.

This is important to permit quick overhauling in case bearing becomes heated or damaged after being assembled with pump on its bedplate.

Gasoline Engine Driving of Fire Pumps.

Paragraph 1. *Amend to Read*: Engines for fire pump service must be of the four cycle type, and must be especially rugged and reliable, etc.

Paragraph 6. Insert following paragraph between 3rd and 4th paragraphs: A governor must be provided for engine capable of adjustment between the speeds of 500 and 1,500 R. P. M.

Paragraph 5. *Amend to read*: There must be two separate systems of electric ignition, one of which must be of the Magneto type. Two sets of spark plugs must be fitted for each cylinder and the ignition systems so arranged that the motor can be started and run from either.

Paragraph 10. *Amend second paragraph to read*: A suitable gasoline strainer, so located as to be easy to clean and replace, must be furnished with engine, and connected close to carburetor.

Paragraph 13. *Amend last sentence of second paragraph to read*: They must be so piped that their discharge is visible to the operator. Unless this can be discharged at a suitable point outside, they should discharge into a cone in the pump room, properly drained.

Paragraph 15. *Amend to read*: All fire pumps operated by gasoline engines must be provided with relief valves. The pump horse-power characteristic of centrifugal pumps must be such that the gasoline engines cannot be stalled at the maximum speed mentioned in Paragraph 6.

Paragraph 20. *Amend to read*: A service tank should be provided, having a capacity for at least one hour's supply for the engine at rated load and not exceeding the following capacities: 500 gallon pump, 10 gallons; 750 and 1,000 gallon pump, 15 gallons; 1,500 gallon pump, 20 gallons. It should be located outside the pump room supplying the carburetor by gravity. A valve should be located in the discharge pipe at this tank controlled by an extension stem from the inside of the pump room.

Insert fine print note after first paragraph as follows:

Although a gravity feed for gasoline is not in line with recognized standards for engine equipments, considerations of safety are secondary in fire pump service to those of certainty of operation. This is not to be taken as a precedent for other equipments.

The above action was approved, the Committee being permitted further consideration with power respecting two items of the report, and it was *voted* to recommend the promulgation of the revised regulations for Rotary and Centrifugal Fire Pumps (including Electrical and Gasoline Engine Driving of Fire Pumps) as of 1920.

The Budget submitted by the Treasurer was approved.

The Secretary-Treasurer was advised to suspend, after due notification, all memberships over six months in arrears for dues, and to consider, in lieu of biennial reprinting, the feasibility of issuing supplements to the general index to subjects covered in the printed records.

The Committee on Automobile Fire Apparatus was suspended.

The Secretary was authorized to suspend the Committee on Uses of Wood in Building Construction if, after conference with the Chairman of the Committee on Building Construction, it should appear that the subject may be properly covered by the latter committee through a possible addition to its membership.

Further changes, if any, in the membership of existing committees will be shown in the forthcoming year book.

The Secretary was directed to advise the Chairman of the Committee on Field Practice to appoint a special conference sub-committee on Hand Chemical Fire Extinguishers to be composed of members of his committee and members of the Association representing the manufacturers of these devices, care being taken to ascertain that the latter members satisfactorily represent the manufacturers of each type of such extinguishers.

A communication from the American Petroleum Institute was considered and the Secretary directed to request of the Institute definite and specific proposed amendments to the Regulations governing Fuel Oil Burning Equipments as adopted by the Association, such definite and specific proposed amendments to be referred to the Committee on Inflammable Liquids for consideration and report to the Executive Committee along with items on this subject referred back to the Committee by the Association at the annual meeting.

It was agreed as desirable that the next meeting of the Committee should be held the latter part of October.

The Tea Tax and the Fire Tax.

By Walter A. Hull

(Member N. F. P. A.)

In 1776 the American people revolted against a tax. It was an extremely small tax; it would not have been burdensome to pay it, but it was abhorrent in principle. The American people of today are paying, without protest, a special tax of our own levying that is heavy enough to be a burden on many of us. The difference seems to lie in the fact that that little tax on tea was announced by royal proclamation and talked about in every family in the land, whereas this greater tax that is being paid so complacently at the present day is camouflaged so that we do not see it unless we take the trouble to look closely. The head of the American household does not go, once a year, to the collector of taxes and pay, for himself and his family, his annual quota of tax to pay for the property that has needlessly been burned in the country during the preceding year; what he really does is to add just a fraction of a per cent to the amount of every check that he writes, to include his contribution to the big pool that is to settle that bill. These checks go to the butcher, to the grocer, the clothier, the landlord, and every other sort of business man, to help meet the cost of his insurance, so that the insurance companies can guarantee him against loss. Now there is nothing so very bad about the principle of this; it is better that every citizen should contribute a little than that the unfortunate family or business man who gets burned out should lose all. The trouble with the system is that too many families and business men are getting burned out. Knowing that the insurance policy will stand between him and ruin if he has a fire, the business man does not exercise sufficient precautions against being burned out; his workmen do not and his customers do not; and the result inevitably is that all of us, those who are careless and those who are not, have to dig down about four times as deep to meet our quota to pay for the big annual bonfire as we would have to do if everyone were to do his part, his reasonable duty to prevent the needless waste of property and of human life by fire.—*Address at Meeting of National Brick Manufacturers' Association.*

Captain Sanislo explaining the hazard of matches to school children.

Seattle Chapter's Unique Secretary.

Captain Stephen E. Sanislo of the Seattle Fire Department is secretary of Seattle Chapter N. F. P. A. No other chapter has a secretary just like him. He has been assigned by Chief Stetson to special duty in fire prevention work, and he is devoting all his time to it—his evenings as well as his days. Captain Sanislo saw service in the Tank Corps during the war. He is an impressive and convincing speaker, making all classes of people realize the hazards he points out. He has addressed 43,000 school children in Seattle during the last six months since his return from the front, and has lectured to over 12,000 adults.

While speaking almost nightly to local organizations of some sort, including women's clubs as well as men's, our chapter secretary does not wait for the people to come to him. He is winning the boundless goodwill of the local merchants and manufacturers, not only for himself, but for the Seattle Fire Department and the N. F. P. A., by going to the stores, plants and factories at any time of the day or night meetings can be arranged, and giving heart-to-heart talks to the employees. Before these talks are given Captain Sanislo makes an inspection of the plant so that he can bring home to the employees by familiar references the

points and hazards he wants their help in safeguarding. The local newspapers are featuring the Captain's work, and the demands for his services by the Seattle industries are so numerous as to suggest a community desire to make Seattle a fire-safe city.

The Captain is resourceful. He wanted to get at the night watchmen of the city to help combat the night fires. He could not hope ever to visit them all on their jobs at night; so he discussed the matter with general Manager Robert T. Reid of the Instantaneous Alarm Company (member N. F. P. A.). Mr. Reid planned to assemble the night men in the plants subscribing to his service in the City Council Chamber at four o'clock one afternoon, and invited all others in Seattle employing night watchmen to send them to the meeting. Captain Sanislo spoke for an hour, which gave them time for their supper before reporting for duty. We are mistaken if this is not the first occasion in the country upon which an officer of the fire department has assembled the night watchmen of a city and appealed for their co-operation. The night watchman is an isolated though important individual generally overlooked. Captain Sanislo has a real idea in going after him. In a number of plants operation has been suspended to permit the employees to listen to his talks. Should anybody be surprised that the membership and influence of Seattle Chapter is growing with a secretary so devoted to the cause of fire prevention? We are proud of the Captain, and we believe Chief Stetson is.

The Forest Fire

These pines could feel the wind, the snow,
The April sun;
But through them now no changes flow.

These pines could feel the grief and mirth
Of quiet years;
But now they know unchanging dearth,

And they can feel no mood of spring—
Like certain souls
Who find in flame their blossoming.

—Gladys Cromwell.

The Housing Problem and Fire.

By R. S. Moulton (Assistant Secretary, N.F.P.A.).

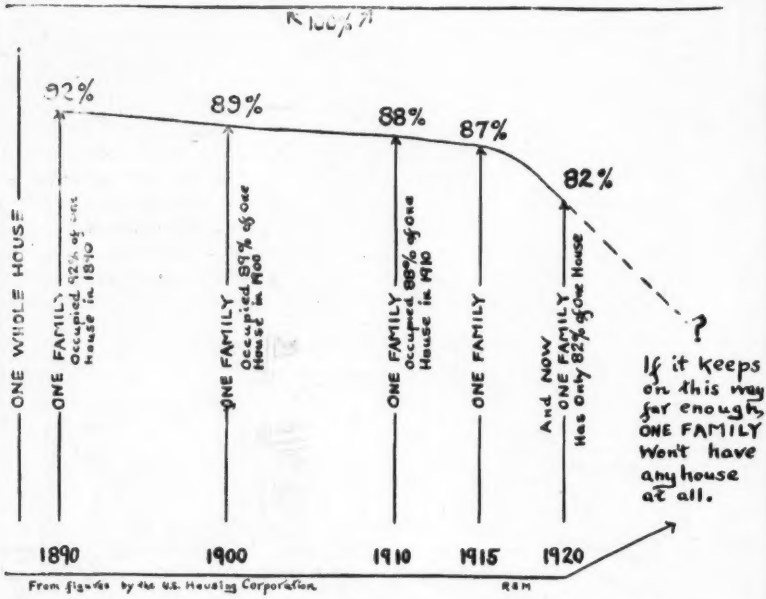
As a well known newspaper cartoonist has aptly expressed it, if the Housing Problem Gets Any Worse,

FOX
KATY TOOK THE PICTURE OUTA THE FRAME AND IT MAKES A DANDY WINDOW!
SOME PEOPLE MAY HAVE TO SOLVE IT THIS WAY.
(Copyright, 1920, by Fontaine Fox)

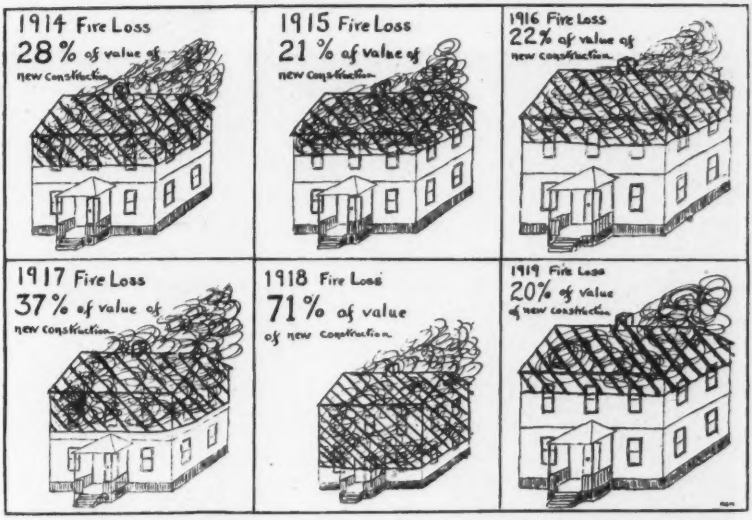
Conditions thus caricatured by Fontaine Fox would appear at first glance to involve a serious fire hazard. They probably do, but if more people than ever before are living in ramshackle, makeshift houses, these same homes are so scarce and so highly prized that they receive a care unheard

of for the same class of property a few years ago. One factor balances the other, or more than balances it, for our 1919 fire loss is just a little smaller than that for 1918 and 1917.

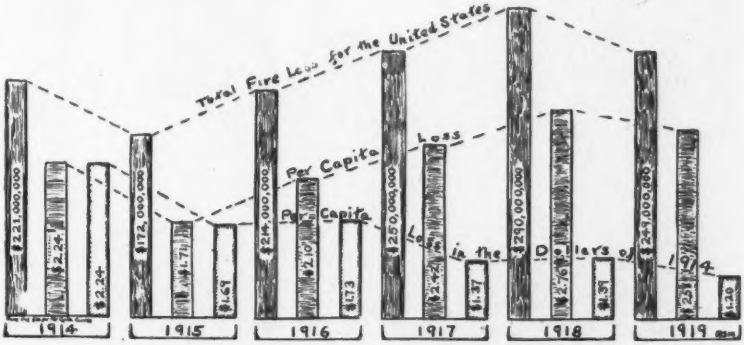
The housing problem is best illustrated, not by any analysis using changing money values, but by using the house rather than the dollar as a unit of comparison. In 1890 there were in the United States 11,483,318 dwellings for 12,690,152 families. In other words, one average American family was permitted to occupy ninety-one per cent of one average house. And now:



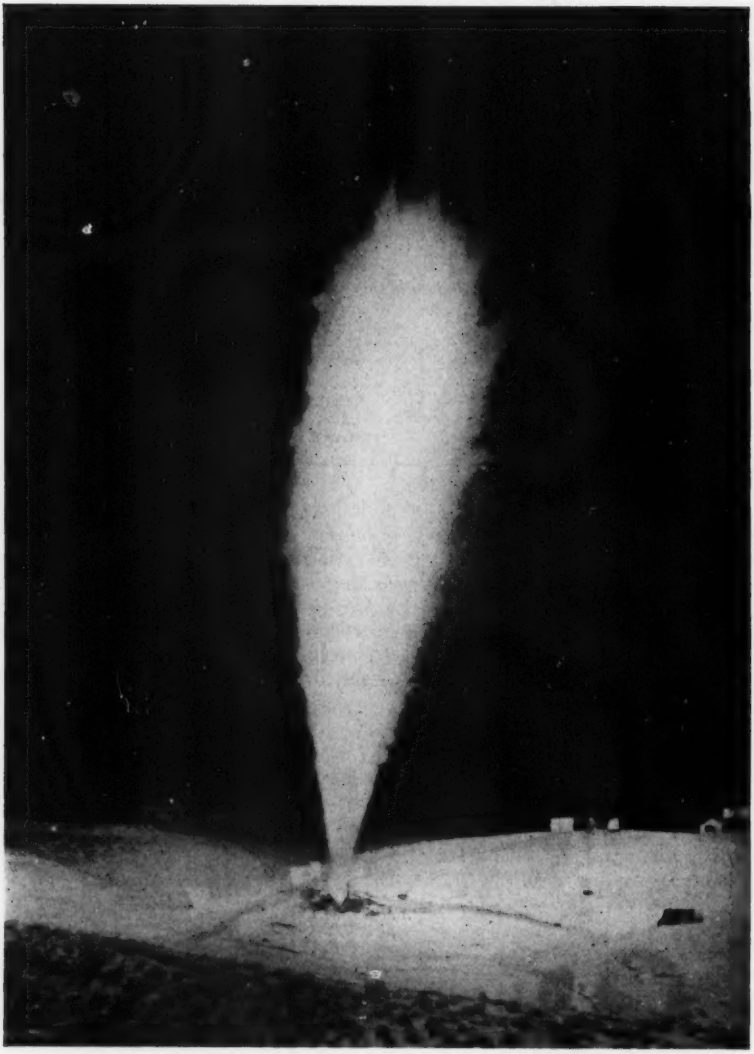
A tremendous effort is being made in many parts of America to stimulate building operations in an attempt to change the trend of this falling curve so that the family won't be crowded into any smaller fraction of a house than it now occupies, or, indeed, be crowded out altogether. Incomplete building statistics for the first half of 1920 indicate that something is being accomplished. Fire loss statistics for the first half of the year are not yet available, but a substantial fraction of the value of the badly needed new houses will be lost by fire, if the unbroken precedent of past years is followed—and it will be followed unless the American people have undergone a revolutionary change of temperament. The ratio of fire loss to new construction is shown by the houses at the top of the next page. The size of the house shows the relative value of new construction; the shaded portion indicates the proportion of this value destroyed by fire for the year represented. The houses are based on data from *Bradstreet's* and the *American Contractor.*


1914 Fire Loss
28% of value of new construction
1915 Fire Loss
21% of value of new construction
1916 Fire Loss
22% of value of new construction
1917 Fire Loss
37% of value of new construction
1918 Fire Loss
71% of value of new construction
1919 Fire Loss
20% of value of new construction

Contrasting with the discouraging fact that, figuratively speaking, more than one-quarter of the new houses built in the last ten years are now blackened ruins, is the hopeful assertion that, while the amount of our annual fire losses may be increasing from year to year, values have so increased that the actual relative fire losses are growing smaller. The following chart is compiled from statistics of fire losses in the United States, published by the *Journal of Commerce*, and the commodity index prices of the U. S. Department of Labor:



But no matter how we juggle statistics, there remains the fact of an enormous annual fire waste which is at least partly responsible for, and continues to aggravate, the Housing Problem.



The largest gas well fire ever known. After burning for ten days and ten nights it was finally extinguished by the use of dynamite. (See article beginning on opposite page.)

"Blown Out" With Dynamite.

How the Largest Gas Well Fire Ever Known was Extinguished.

By A. H. Clough,
Technical Expert, Giant Powder Co., San Francisco, Cal.

What is conceded to be the largest gas blaze ever encountered in the oil producing industry occurred at one of the wells near Taft, California, about midnight July 26, 1919.

With a flow estimated at one hundred million cubic feet of gas every twenty-four hours, shooting upward under enormous pressure, the well blazed for ten consecutive days and nights. All known methods of extinguishing it were tried and proved of no avail, until the plan of putting it out with explosives was submitted and tried. To Ford Alexander belongs the credit of this idea, who risked his life in bringing his plan to a successful issue.

The Standard Oil Company was drilling with a rotary drill in well No. 7, in the Elk Hills, near Taft, in the Midway Oil Fields, California. The well was at a depth of 2,135 feet in ten-inch casing, when a supposed water sand was encountered. To test this sand for water, the mud in the well was bailed down to relieve pressure and to allow any water present to accumulate in the well. During the course of bailing, at 11 p.m. July 26, the well blew out under tremendous pressure, and the greatest flow of gas in the history of oil production began.

The drilling crew attempted to get the well under control by closing the 12½-inch gate valve with which the casing was equipped, but the shale and sand carried by the stream of gas cut out the seat of the valve while the gate was being closed, and the well continued to blow. Two hours after the flow began the friction caused by shale and sand traveling at great velocity had produced a red heat on the casing, and the gas, igniting, burst into a column of fire, gushing 300 feet skyward.

The maximum width of the flame, about fifty feet, was reached about 100 feet above the ground. The gas emerged from the casing with such force that for a distance of twelve feet about the casing there was no flame.

The derrick, 100 feet in height, was immediately consumed, and all that remained was a twisted mass of iron and machinery. Metal at the casing melted, while within a radius of fifty feet it was brought to a white heat. Everything within hundreds of feet was burned and baked. A thermometer, registering 300 degrees F., broke at a distance of 250 feet from the fire. It is reported that the fire could be seen for a distance of eighty miles, while the roar from the escaping gas could be heard at a distance of ten miles. Men could not hear each other shouting within a radius of 1,000 feet of the well, and deafness resulted among the fire-fighters. All plans were carried out by signal.

The first attempt to extinguish the fire was made July 27 by the assembling of ten boilers. From both the blowoffs and the steam connections of these boilers three-inch lines were laid to within fifty feet of the well, where each branched into two two-inch lines and ran to the base of the flame. With the base of the flame twelve feet above the ground level, the work of laying these pipe lines, nevertheless, became a matter of human endurance against heat. The men worked behind large portable metal screens, with a stream of water constantly playing upon them from a three-inch fire hose. Water lines were also laid, and with the boilers and pumps throwing steam and water into the flame to their full capacity, there was no noticeable effect upon the fire.

Shortly after this all the casings above ground blew off, and the well began to crater, allowing the flame to draw down to the ground level.

The second attempt was made with the full capacity of sixteen boilers and four pumps throwing steam and water through three and four-inch lines, but this effort showed no better results than the first.

The third attempt was made with twenty boilers throwing steam and water, four rotary pumps throwing water, two 125-barrel water tanks with four-inch steam jetted lines, and two pumps throwing fire foam.

With the preparation for the fourth attempt completed, there were twenty-one three-inch lines and nine four-inch lines into the fire crater. Twenty boilers and eleven rotary pumps were ready to throw steam, water, mud and carbon tetrachloride. This attempt and also the fifth attempt to extinguish the fire were failures.

Thus through the fatiguing efforts of nine days and nights, in which time the company expended nearly a half million dollars, they arrived at the point where all effort seemed in vain, and had reached the end of their resources.

Officials of the company brought artillery officers from the Western Department, U. S. Army, who considered bombarding the well with field howitzers, but who reported that portable artillery was too small in calibre to accomplish the task.

The company now considered the idea advanced by Ford Alexander of conquering the fire by explosives. Mr. Alexander does practically all of the oil well blasting in the California fields, wherein Giant brands are used exclusively by him. His experience and knowledge of explosives led him to the idea advanced, which was, essentially, to suspend a package of Giant Blasting Gelatin upon cables, in such a manner that the package could be safely brought to the edge of the fire at a distance of about forty feet above the ground.

Three derricks, approximately 100 feet high, were erected on three sides of the burning well at a sufficient distance so that the heat would not destroy them. A $\frac{9}{16}$-inch steel cable was attached to the top of one of them, then laid around the well outside of the terrific heat zone, to another derrick, where it was run through a pulley at the top and the end attached to the drum of a small winding engine underneath. A guide wire was run to the third derrick to give a three point suspension, and thus exact control.

The explosives, bound in one package and covered with heavy asbestos, were securely attached to this cable at the same distance away from the first derrick as the burning well was. The explosives, before being made up into this package, had been primed electrically. When this was done, the engine under the second derrick began drawing the cable taut, which pulled the explosives toward the well and at the same time hoisted them. When they had reached the proper spot they were to be exploded electrically. It is unnecessary to state that this had to be done very quickly so as to bring the explosive charge to the necessary point before they were ignited or exploded by the heat from the burning well.

With a stream of water from a three-inch hose playing upon him, upon the protecting screen behind which he was working, and upon the ground over which he was advancing, Mr. Alexander worked forward with the explosive package for the purpose of being sure that the package was in the position he wanted it at the moment of explosion.

As the package drew near the column of fire, the suction of rushing air drew it to the flame, and as it reached the outer edge of the fire Mr. Alexander exploded the charge. At the moment he exploded it he was within 200 feet of the explosion, but states that he neither heard nor felt anything.

Eye witnesses at a greater distance state that when the package exploded the gas well fire was divided into three sections. The section at the point of explosion was moved bodily away from the column of gas in a horizontal direction, the upper section was blown upward and beyond danger of re-ignition of the gas column, while the lower section was snuffed out very much as a candle is snuffed out, the flow of gas being temporarily checked.

To get an idea of the enormous amount of gas flowing from this well, one has but to note that the entire city of San Francisco consumes but 14,000,000 cubic feet of gas each day, and that this well alone would supply more than enough gas for seven cities the same size.

The Standard Oil Company expended nearly a half a million dollars in vain attempts to extinguish the fire, and had arrived at the end of its resources in oil well fighting. Army artillery officers were called upon, but could advance no plan to snuff out this colossal blaze. Then explosives came to the aid of men, displacing old ideas and methods with new ones that are more economical. In the future, gas well fires, oil well fires and oil reservoir fires will be extinguished with explosives at a cost small compared with what has heretofore been expended.

Shingle Roof Conflagration,
Grandview, Texas.

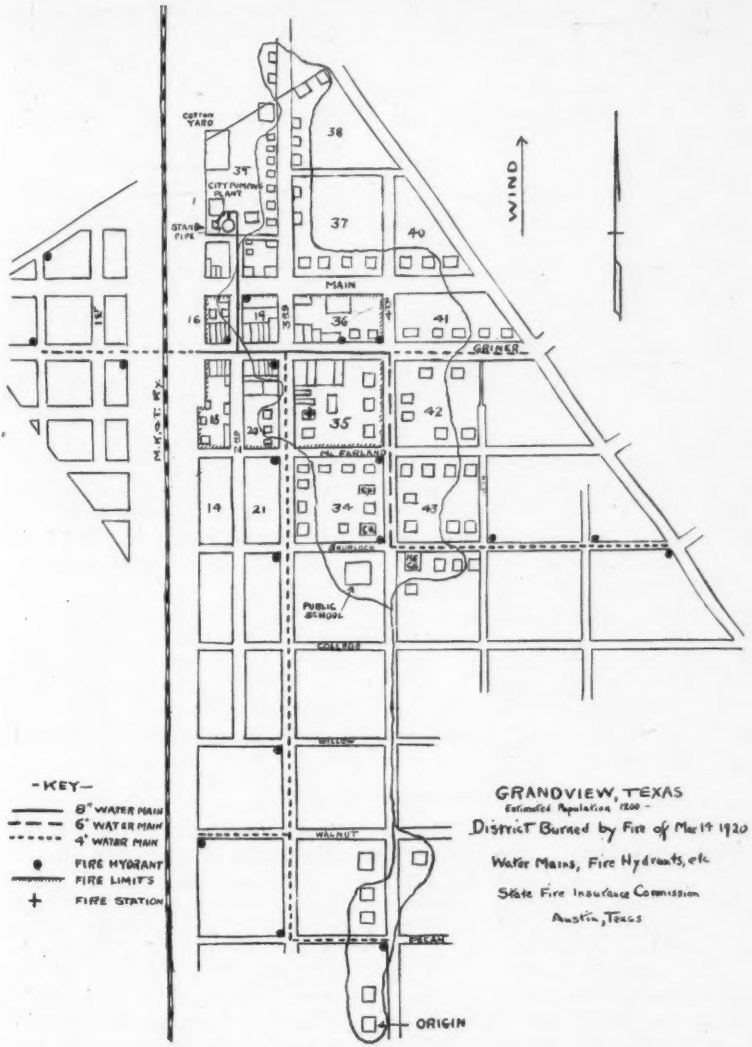
Report by S. W. Inglish, State Fire Marshal.
(Member N. F. P. A.)

Another conflagration has forcefully illustrated the hazard of the shingle roof. Grandview, Texas, a village of 1,200 inhabitants, has been visited by a fire which destroyed a total of one hundred and thirty-six buildings. An inadequate water supply prevented effective work by the fire fighters, but in the case of one building, a warehouse, this was supplemented with good results by the liberal use of salt and vinegar.

Story of the Fire.

The fire originated shortly after noon on Sunday, March 14, 1920, in a two-story frame shingle roof residence on Fourth Street, at the extreme southern edge of town, five blocks south of Shurlock Street. It has been fairly well established that the cause was defective wiring, the owner stating that the fire was first observed around a ceiling outlet on the second floor. The fire had probably gained good headway in the attic before being discovered, and as a gale was blowing from the south, with an estimated velocity of thirty miles an hour, there was little chance of controlling the flames after they had once burned through the roof. An idea of the force of the wind may be gained from the fact that embers were carried a mile and a half northward to a shingle roof barn, which was burned to the ground soon after the house at the point of origin of the conflagration was consumed. This wind blew steadily all day and throughout the night.

Four other dwellings immediately north of the point of origin were burned. The fire then passed over a low strip of ground three blocks wide to the school, a large frame shingle roof structure, thence to the northern edge of town, destroying a section from one to three blocks wide, including most of the mercantile district. Blocks 35, 36, 19 and 18 were entirely burned, as were most of the buildings in Blocks 34, 43, 41, 37, 38 and 39. In Block 20, only the brick mercantiles at B-228, E. Criner Street, and 48-49-50, Second Street, iron-clad warehouse at 30, Third Street, and dwelling at 33, Third Street, were saved. An unusual circumstance was noted in this block, wherein five brick mercantiles were burned and two frame dwellings, but a large intervening iron-clad warehouse was saved by the liberal use of salt and vinegar which happened to be stored therein.



Buildings Burned.

20 Brick Mercantiles.
7 Frame Mercantiles.
5 Churches (Frame).
1 School (Frame).
35 Frame Dwellings.
2 Lumber Yards.
16 Negro Houses (on 3rd Street, north of Main).
50 Frame Barns and Outbuildings.

Total number of buildings, 136.

An open yard containing 705 bales of cotton, located north of the Grandview Mill and Elevator Company, and about one block west of the path of the flames, escaped only by the efforts of a large corps of workers. Bales that caught fire and could not be extinguished were removed beyond exposure distance of the remainder of the cotton. A total of 13 bales were destroyed and 14 damaged.

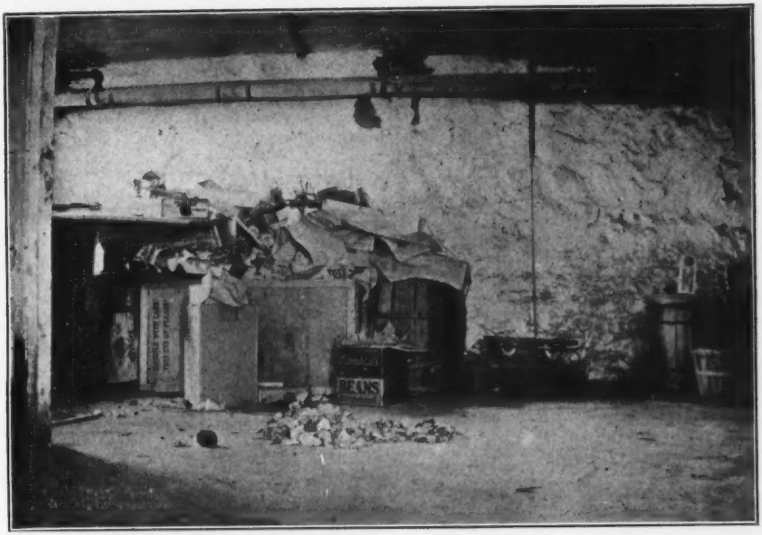
Fire Protection.

The pumping equipment consists of a centrifugal pump rated 500 g.p.m. against 100 lbs,, direct connected to a 50 h.p. induction motor. This pump takes suction from a 12 ft. by 100 ft. standpipe, which is said to have contained 95 feet, or 80,000 gallons of water, at the time the fire department responded to the alarm. There is one well in use, pumped by a 50 g.p.m. motor-driven deep well pump, which discharges direct into the mains. Current is obtained from the transmission line of the Texas Power & Light Company, which was not affected by the fire. The pump station is a small fire-resistive building located adjacent to the Grandview Mill and Elevator Company, slightly out of the path of the flames. The water on hand apparently lasted two or three hours, but small amounts were furnished afterward by the well pump.

The fire department apparatus consists of a 50-gallon hand-drawn chemical and an auto combination wagon with 35-gallon chemical and 800 feet 2½-inch hose; also one reel in reserve with 500 feet 2½-inch hose. This apparatus reached the fire promptly, and two hydrants were available within 300 feet, but both were supplied by the same dead end 4-inch main, one-half mile long, and the amount of water obtainable was of no practical value. Apparatus also responded promptly from Itasca and Alvarado, each nine miles distant, and from Cleburne, fifteen miles distant, and was of service in saving property located outside the direct path of the flames. The only pump available was a 350 g.p.m. Am. LaFrance from Itasca. Hose from Alvarado was non-standard thread and could not be used.

Lessons from the Fire.

This conflagration affords another striking illustration of the hazard of the wood shingle. The lesson may also be drawn from its consequence that long leads of 4-inch fire mains are almost without value for fire protection in emergencies. Furthermore, it was fully demonstrated in the fact that one of the neighboring towns responding to the call for assistance could be of but limited aid, that there is imperative need for standardizing all hose couplings throughout the State. The efficiency of the service rendered in saving the large open-yard storage of cotton is likely without parallel in our history of fire fighting; and the same may be said in connection with the successful efforts at turning the course of this fire from the large iron-clad warehouse at No. 30 Third Street.

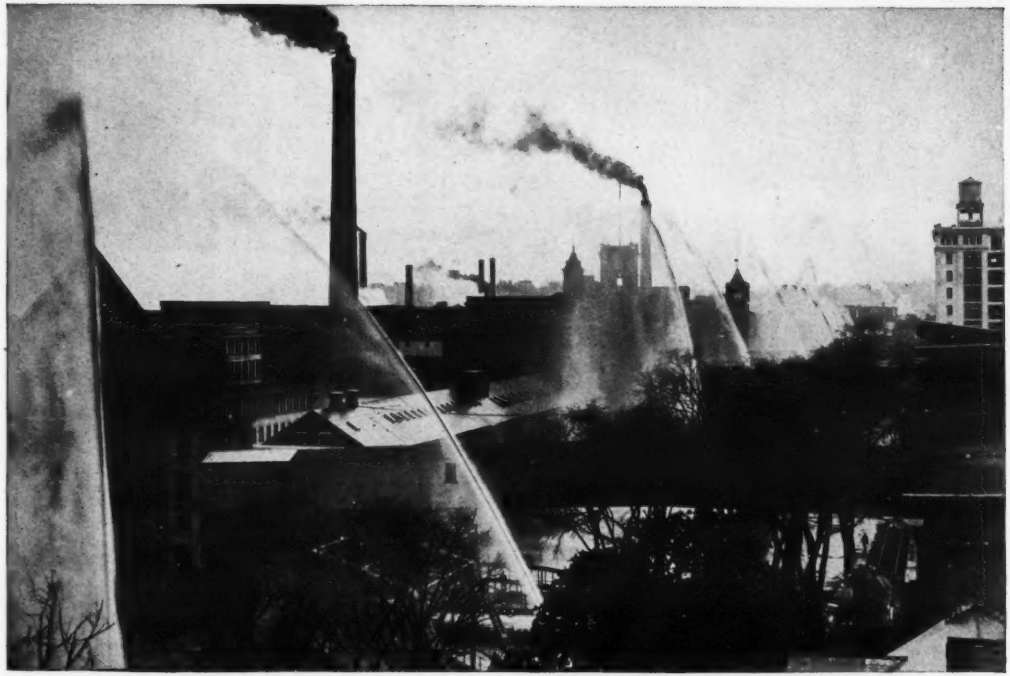


(Photograph by H. L. Miner (Member N.F.P.A.)

A Dangerous Basement.

This photograph shows a number of hazardous conditions that are all too common in the homes of North America. The picture was taken with the camera placed beside the furnace, and shows conditions directly in front of the heating plant. Some of the hazards are:

1. Refuse and Waste Paper.
   Highly inflammable material subject to quick hot fire.
   Danger of fire from spontaneous combustion.
   Burner of gas stove dangerously close to easily ignited material.
   Sparks from furnace.
   Furnace man smoking in basement.
2. Improperly Arranged Temporary Laundry Stove.
   Insecurely supported on wooden base.
   Unprotected flame dangerously close to highly combustible material.
   Flexible tube to gas stove with slip connectors.
3. Ashes Placed in Wooden Barrels, Boxes and Baskets.
   (See extreme right in photograph.)
4. Loose Tip Matches found on top of barrel with metal cover, also on shelf near rubbish—burned sticks on floor at gas stove.
5. Openings Into Concealed Spaces — floor joists and partitions — around pipes. (See upper left-hand corner of photograph over rubbish).



Test of Co-operative Fire Protection System in Lawrence, Mass. (See opposite page.) This view is looking west from Union Street, with camera 60 feet above the ground. Eight of the fourteen two-inch streams of Test No 2 are shown. Hydrant Pressure 82 lbs.

Co-operative Fire Protection.

Report by Inspection Department, Associated Factory Mutual Fire Insurance Companies.
(Member N. F. P. A.)

A test of one of the largest, if not the largest, private joint fire protection system in North America has recently been completed. At Lawrence, Massachusetts, there are a number of large mills situated along the North Canal, each protected by a complete fire system of automatic sprinklers, yard hydrants, etc. In order that the total water supply of these seven fire systems might be available at any one of the mills, a 16-inch main connecting all these yard systems together has recently been completed in accordance with recommendations and plans furnished by the Associated Factory Mutual Fire Insurance Companies. This joint system enables the mills to help each other by concentrating their fire pump capacity of 27,000 gallons per minute at any one yard in case of a serious fire, or to co-operate in protecting these valuable mill properties against exposure from the adjoining wooden tenement district.

The abundant water supply which can be obtained from a large joint fire protection system was strikingly demonstrated by an operative test of this system at Lawrence, Mass., on May 14, 1920. During the test fifteen 2-inch streams and six 1¾-inch streams, each from a three-way deluge nozzle, were discharging at one time, representing a delivery of 17,000 gallons per minute, with an average hydrant pressure of 82 lbs. This did not represent the entire capacity of the system, as five of the pumps were not used, and several ran considerably below full speed.

The mills co-operating are: Pacific Mills, American Woolen Co., Pemberton Co., Geo. E. Kunhardt Corp., Everett Mills, Champion-International Co., Lawrence Duck Co.

This group of seven mills, extending for about a mile along Canal Street, have shared the expense of installing a 16-inch private water main parallel to their properties. To this main the yard fire protection system of each mill has been connected in such a way that by closing one or two valves in each yard the mill systems are independent as formerly, but by keeping the valves open as planned, the new main will furnish an auxiliary water supply of large capacity.

Normally the interconnecting main is under city water pressure, fed by six 12-inch, one 10-inch, six 8-inch and two 6-inch connections from the city mains to the various yard systems. Under these conditions the main serves as a supplementary primary supply, while in time of fire the pumps at each plant taking suction from the canal and river can deliver into this main about 27,000 gallons of water per minate at 100 lbs. pressure. There are twenty-four pumps which can discharge into the main, with a total rated capacity of 27,000 gallons per minute. This pumping capacity, which is to be increased in the near future to 30,000

from Union Street, with camera 60 feet above the ground. Eight of the fourteen two-inch streams of Test No 2 are shown. Hydrant Pressure 82 lbs. (See opposite page.) This view is looking west

gallons per minute, is ample to supply hose streams and automatic sprinklers for any mill fire which may be expected, with a liberal amount for reserve. In case of a conflagration the water supply would be sufficient for open sprinklers and a good number of hose streams of ordinary and large caliber.

Three-way hydrants have been installed at frequent intervals along Canal Street and also on Methuen Street at the corner of each intersecting street. Hose lines from these hydrants can be used by the mills or the Fire Department as a protection against the exposure to the north.

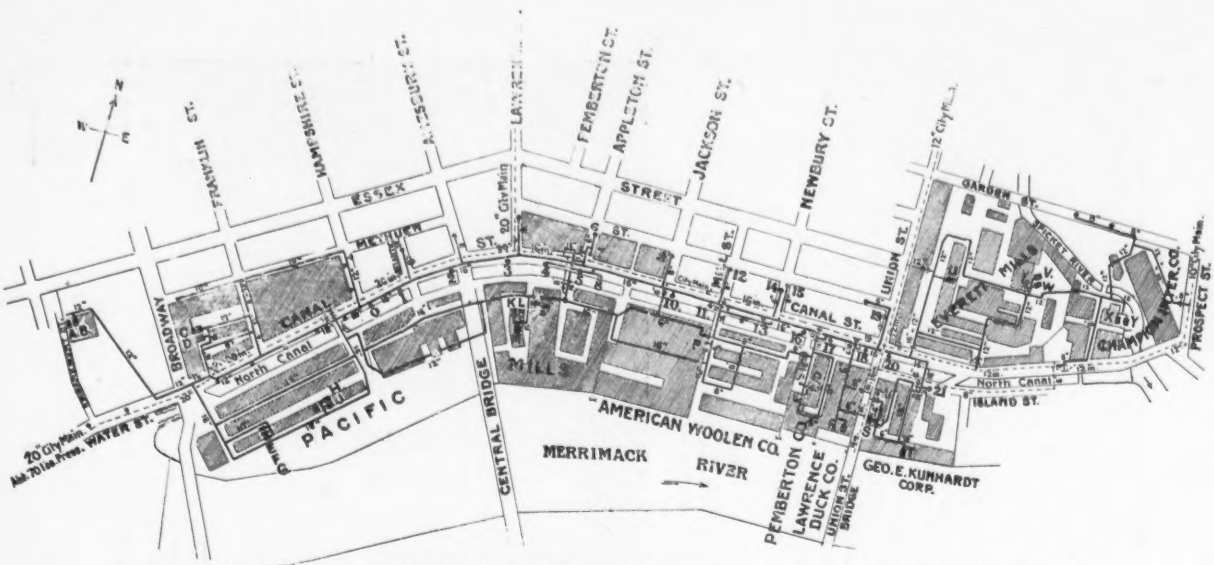
The test of the completed system was planned and conducted by the Inspection Department, the pumps and hose lines being manned by the engineers and fire brigades of the various mills, assisted at four hydrants by hose companies from the Lawrence Fire Department. As the pumps and hydrants were widely separated no signals could be conveniently arranged. The tests were therefore carried out according to a prearranged time schedule which was distributed to all concerned. The program was followed exactly as planned, promptly and without accident of any kind, observations of pressures and pump speeds being taken simultaneously.

The object of the first test was to determine how long it would take for the pumps to raise the pressure in the entire combined system, including the automatic sprinkler systems in the various mill buildings, from the city pressure of 70 lbs. to 100 lbs. With one 2-inch stream opened as a relief discharging about 1,000 gallons per minute the pressure reached 100 lbs. in less than two minutes.

The second test was planned to show a group of 2-inch streams all fed by 50 feet lines of hose through three-way Siamese connections, thus giving as high nozzle pressures as could be expected under ordinary fire conditions. Fourteen 2-inch streams were used, with a total discharge of 12,690 gallons per minute. During this test the deluge nozzle pressures ranged from 54 lbs. per square inch with a discharge of 860 gallons per minute to 65 lbs. per square inch with a discharge of 950 gallons per minute. One of these was a water tower of the Lawrence Fire Department, supplied from the new main by four hose lines. The 2-inch nozzle was raised about 45 feet in the air, and the stream from it reached practically the same height as the streams from the 2-inch Eastman nozzles located at the ground. The stream from the water tower, however, was more solid at its extreme height.

During this test only six of the pumps were delivering their rated capacity, although at all pumps the pressure was between 95 and 105 lbs. per square inch, and the hydrant pressures ranged from 80 to 90 lbs. The total estimated delivery of the pumps was 18,770 gallons per minute. The delivery in excess of that measured at the nozzles was largely wasted at the relief valves, many of which discharged more or less throughout the test.

The third test was intended to show the capacity of the system available when the mills were running and with the rotary pumps held in reserve. Hose lines 200 and 250 feet long supplying 1¾-inch nozzles through three-way Siamese connections were used during this test for comparison with adjacent 2-inch nozzles fed by short hose lines. The nozzle pressures ranged from 51 to 65 lbs. (except where partly ob-



TEST OF INTERCONNECTING MAIN ALONG NORTH CANAL, LAWRENCE, MASS., MAY 14, 1920.

Scale of Cut, 1 in. = 875 ft.

LIST OF FIRE PUMPS

A—1000 Gal. Worthington Steam Und.
B—1000 Gal. Worthington Steam Und-
C—1000 Gal. Worthington Steam Und.
D—1000 Gal. Worthington Steam Und.
E—1500 Gal Worthington Steam Duplex
F—100 Gal. Worthington Steam Duplex
G—1500 Gal. Worthington Steam Duplex
H—1000 Gal. Knowles Steam Und.
J—1000 Gal Knowles Steam Und.
K—1500 Gal. Worthington Steam Duplex*
L—1500 Gal. Worthington Steam Duplex
M—1000 Gal. Worthington Steam Und.
N—1500 Gal. Worthington Steam Duplex
O— 750 Gal. Worthington Steam Duplex
P—1000 Gal Knowles Steam Duplex
Q—1000 Gal. Fales & Jenks No. 4 Rotary*
R—1000 Gal. Fales & Jenks No 4 Rotary*
S— 750 Gal. Knowles Steam Und
T—1000 Gal. Fales & Jenks No. 4 Rotary*
U—1000 Gal. Fales & Jenks No. 4 Rotary*
V—1500 Gal. Blake Steam Duplex
W—1500 Gal. Blake Steam Duplex
X—1000 Gal. Deane Steam Duplex
Y—1000 Gal. Deane Steam Und.

*Did not run during this test

VIEW LOOKING EAST ACROSS UNION STREET

Four of the fourteen streams of Test No. 2 from Hydrants Nos. 17, 18, 20 and 21. Hydrant pressure 85 lbs. The spraying of the stream at the left is due to the Pitot tube used to obtain the nozzle pressure.

structed). The discharge from each 1¾-inch nozzle was about 650 gallons per minute, and from each 2-inch nozzle from 850 to 950 gallons per minute. The total discharge of twenty-one streams was 17,000 gallons per minute, or 4,500 gallons per minute less than the rated capacity of the pumps which were running. This was due to the natural hesitancy of the engineers to materially exceed 100 lbs. pressure at the pumps. Consequently five of the pumps operated during this test at less than half speed, and yet maintained hydrant pressures as before of 80 to 90 lbs. Evidently four more 2-inch streams could have been used during this test without lowering the pressure.

The cuts show the appearance of the streams. It will be seen that they were effective for use in the upper stories of practically all of the mill buildings, but would not reach the top story of the concrete storehouse of the American Woolen Co. This building is 125 feet high, and while the extreme drops of some of the 2-inch streams reached this elevation, the stream would not have been effective for fire fighting at this height.

During the test several of the Eastman nozzles became partly obstructed due to foreign material lodging in the vanes, and several hydrants had to be closed in order to clear the nozzles. This objection has been noted before, and the Inspection Department is already working on this problem in the hope of securing a satisfactory type of deluge nozzle which will give smooth, long range streams without the necessity of using interior vanes.

On the whole, the test was a successful demonstration of the greatly increased protection afforded the mills and the city in general by the installation of this 16-inch interconnecting main, and the co-operating mills are entitled to great credit for the manner in which the whole work was undertaken and installed. The care and maintenance of this private main, together with the valves and hydrants connected to it, is under the supervision of a committee composed of Mr. W. D. Twiss, superintendent of the Everett Mills, Mr. F. A. Wallace, engineer of the Upper Pacific Mills, and Mr. W. D. Knowlton, engineer of the Washington Mills. A scheme is now being worked out whereby the valves in the connections to the various yard systems will be kept open at all times and fire pumps started promptly in case of fire.

This joint system is an excellent example of what can be done by co-operation along fire protection lines, and could be studied to advantage by other groups of mills similarly situated.

Pump Log.

		Test No. 2 Fourteen 2" Streams flowing			Test No. 3 Fifteen 2" Streams and six 1 3/4 Streams flowing		
Pump Designation	Rated Capacity	Pump Press. Lbs. per sq. in.	Rev. per Min.	Estimated Discharge G. P. M.	Pump Press. Lbs. per sq. in.	Rev. per Min.	Estimated Discharge G. P. M.
A	1000	100	66	940	108	80	1140
B	1000	102	62	890	108	70	1000
C	1000	100	60	860	100	91	1300
D	1000	100	80	1140	105	87	1240
E	1500	100	27	600	100	23	510
F	1000	98	62	730	98	66	780
G	1500	100	12	270	100	19	420
H	1000	105	84	1200	125	116	1780
J	1000	110	72	1030	120	106	1510
L	1500	100	16	390	100	29	710
M	1000	100	21	300	100	18	260
N	1500	104	34	830	103	39	950
O	750	104	50	590	104	55	650
P	1000	95	55	740	95	57	770
S	750	100	70	810	107	70	810
V	1500	95	56	1540	100	68	1880
W	1500	100	58	1600	100	68	1880
X	1000	100	4	50	100	4	50
Y	1000	100	48	680	107	79	1130
	21500			15190			18770

NOTE.—In the above estimates a slip of 10% was allowed for underwriter fire pumps and 15% for mill pumps. The delivery in excess of that measured at the nozzles was largely wasted at the relief valves, many of which discharged more or less throughout the test.

Pump K was used for boiler feed during the test.

Pumps Q, R, T and U could not be operated while mills were running.

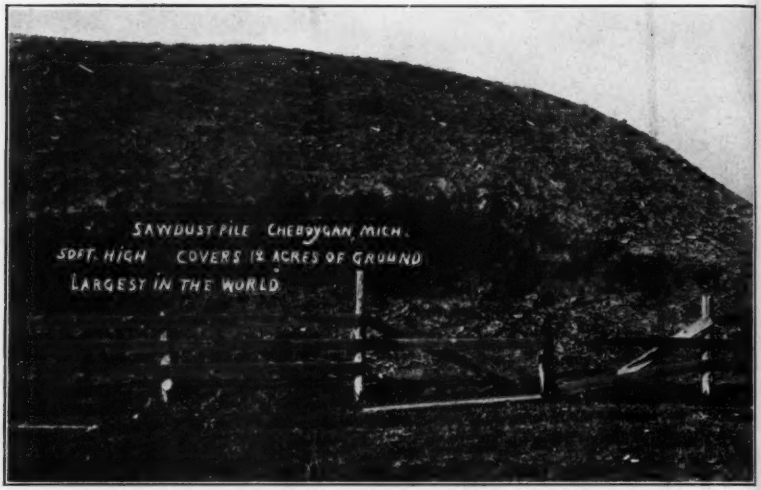


Fig. 1. This mountain represents 150,000,000 feet of merchantable lumber and is an accumulation of 50 years.

Sawdust: Its Fire Hazard.

By Charles E. Worthington

(Member N. F. P. A.)

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Given a combustible waste material, produced in sufficient volume to constitute a fire menace, the menace is likely to diminish in proportion as economic uses are discovered and its value enhanced.

Sawdust, as everybody knows, consists of small particles of wood torn or cut by saws during various processes of manufacture. But while sawdust is a perfectly familiar product, and many of its minor uses well known, few are aware of the enormous economic possibilities it holds or the hazards of fire it embodies.

Being wood, its chemical constitution is mainly cellulose and lignose. Cellulose is the basic form from which starch, sugar and numerous other substances of great economic value are derived, and this the sawdust pile holds in immense quantities awaiting the chemist who can successfully evolve methods of extraction and conversion on a profitable commercial scale.

Besides the substances named, there are many mineral elements varying more or less with the kind of wood from which the dust is made; oil gums and resins, all more or less capable of extraction on a commercial scale.

The production is enormous. In no other country in the world has lumbering and the manufacture of articles wholly or in part of wood

been developed on anything approaching the same scale as in the United States and Canada, and every saw in every factory using wood produces sawdust.

The tremendous possibilities of the material have been appreciated by chemists, who have long endeavored to work out practical methods for complete utilization, some of the most promising of which are of recent development.

One of the chief handicaps has been what may be termed the "destructive" method of lumbering, the complete cutting out of a tract of standing timber, amounting to deforestation, followed by the removal of the mill to some new location to repeat the process.

In this manner immense territories have been practically denuded of timber of usable size, while the period of operation at one location has often been too short to justify the expense of establishments for utilizing the waste; consequently, enormous accumulations still exist, like the vaunted sawdust pile of Cheboygan, Michigan. (See Fig. 1.)

This method of lumbering is being superseded by the more rational method of selective cutting over a larger territory, bringing the logs by tramways from considerable distances, and a system of scientific reforestation, intended to give permanence to the operations. This is wholly practicable—as also in tracts traversed by water courses of sufficient magnitude to float the logs to the mills.

This latter method is making possible the utilization of the waste, since it is now practicable to erect a plant for that purpose at a considerable expense and distribute the cost over a number of years, which was inexpedient with a merely temporary location.

Besides the well-known common uses as absorbent, packing material, fuel and insulation, there are commercially possible products, and industrial chemistry is still continuing its never-ceasing endeavors, for the keynote of modern progress is utilization of waste.

A few of the uses may be enumerated:

Fertilizer. There is a considerable percentage of soluble potash in the ashes of hard woods, and some business is done by saving, sifting and marketing these ashes, which are in good repute as a fertilizer. This product is mainly derived from Canada.

Potash. At one time a considerable business was done by leaching hard wood ashes and evaporating the lye for crude potash. In the earlier days when wood was the universal fuel almost every family maintained its leaching barrels and grease tub for making home-made soap.

Soap manufacturing, however, as an art has made such progress that comparatively little is now done in this manner. Of leaching on a commercial scale no information obtainable suggests that it is now practiced to an appreciable extent, the product having given way to potash largely derived from the natural deposits.

Linoleum. In linoleum making, ground hardwood sawdust is used to at least some extent, and such use is said to be increasing.

Wood Alcohol. The production of this by dry distillation has been carried on to some extent, mainly at such hardwood sawmills as were provided with a timber supply calculated to last for several years.

The process, in brief, consists of subjecting the sawdust to the action of heat in closed retorts, the products being wood vinegar (crude pyroligneous acid), tar and various gases and vapors, some condensible and of value.

From the tar product collected and re-distilled is produced a considerable variety of things of commercial value, mainly pitch, light and heavy tar oils, alcohol, acetone and acetic acid. Sometimes the vinegar is refined and sold for table use. The residue in charcoal is considered too friable to be marketable and is utilized as fuel for the stills.

The sawdust from some coniferous woods yields turpentine and resin, but the yield of alcohol by dry distillation is not as great, hence chemical research has turned to processes of fermentation which have attained considerable practical value.

In this process the sawdust is first treated with acids to convert as much as possible of the cellulose into fermentable sugars.

The liquor containing these is drawn off, neutralized by alkalies, fermented by suitable cultures and finally distilled in the usual manner.

A yield of 20 gallons of wood alcohol to each ton of dry sawdust is said to be the average output, rendering this a possibly profitable enterprise where the sawdust supply is of sufficient volume and permanence, and the cost of handling not too great.

Chemical utilization of refuse, long in vogue under European conditions, is coming to the front under modern methods of lumbering, the refuse assuming a value too great to permit of its treatment solely as waste, thereby diminishing, at least to some extent, the general fire hazard.

There is some use of sawdust mixed with glue and molded under heat and pressure for ornaments for furniture, and by similar methods, by the use of blood, gelatine and other binders, artificial lumber has been made. There seems to be no record of any production of this last named in the United States on a commercial basis.

Presumably, as present processes are slowly perfected and improved, other economic uses will be found and the waste assume such tangible value as will induce conservation and care in handling.

Fire Hazard.

The most generally recognized hazard is that of ignition by external causes. We would expect to find so combustible a material as wood, when in a finely comminuted state, exceptionally sensitive; but fresh sawdust, or even that from dry storage, although perfectly dry, is rather difficult of ignition. It responds at once to flame applied superficially, but contact with merely glowing material often fails of effect.

This last statement should be qualified somewhat, as a glowing mass of sufficient bulk will produce ignition on a prolonged contact, or, if it be buried in the pile to even a moderate depth, glowing material in contact, in a brisk draft, or if the sawdust itself is warm, is likely to be effective.

Again, sawdust, being composed of wood, shares in the general characteristics of wood, and wetting and subsequent drying lead to the

selective absorption of oxygen, producing a condition of rapid combustibility and a great increase in sensitiveness. This is marked if this drying by heat be sufficient to produce browning. This change in condition is more rapid in the sawdust than in solid wood. There is a general agreement among authorities that there is no very material difference in action due to the particular wood from which the sawdust is derived, although there is in all probability a more flammable condition in resinous sawdust and possibly slower chemical changes in some directions in wood of large acid content.

The exact condition of the sawdust in any given pile or accumulation is not determinable in any ordinarily practicable manner, and for the sake of reasonable safety we must assume that every accumulation has already reached a condition of sensitiveness, hence the essential value of great care, not only in removal of any accumulations discovered, but in preventing any such in the beginning. A daily clean-up of factories and mills working wood brings the most important measure of safety, with also all possible precautions to protect from sparks.

Spontaneous Combustion. Sawdust being chemically in the main cellulose and lignose is subject to the reactions that affect other similar forms of carbon. There may be said to be three ways in which this faculty of self-destruction is produced.

(1) By external heat:

When wood in any form is subjected to the protracted influence of even moderate heat under conditions that obstruct ventilation and radiation, certain changes of structure take place, viz.: up to 230° F. moisture is first expelled, followed by some expulsion of volatile content; up to 305° F. carbon dioxide is expelled, with browning and structural modification of the wood. Up to 537° F., formation of pyrophoric carbon—a structural state in which the wood at time of formation and for some time afterward has the power of absorbing oxygen rapidly enough to produce actual ignition.

It will be noted that the highest temperature named is still well below the point where a wood surface may be directly ignited by dry heat.

And it may be noted also that not only does the subdivision of the wood facilitate passing through those changes more rapidly and at lower temperatures than those given, but it also provides for the more rapid absorption of oxygen because of the greater comparative extent of exposed surfaces. Further, the non-conductivity of the sawdust pile favors retention and accumulation of heat.

Wood subjected to alternate heating and cooling tends towards this condition and becomes extremely combustible, even before browning is manifested. This is due to the natural presence of moisture and the tendency when this is driven out to reabsorb an equal amount. Wood, however, has a selective affinity for oxygen, and the reabsorption is in part oxygen which enters into chemical combination with the wood. Thus when flame is applied the fire (which is merely rapid oxidation) has less work to do and ignition is easier and destruction more rapid.

Thus sawdust accumulation upon steam pipes is extremely dangerous. The temperature of saturated steam (Rankine) is as follows, approximated from the tables:

Pressure 25 lbs. Temp. 240° F.
Pressure 55 lbs. Temp. 290° F.
Pressure 70 lbs. Temp. 305° F.

Bearing in mind that length and intensity of exposure are largely interchangeable, a longer exposure to a lower heat having a similar effect to a shorter one at higher heat, and that the process of ignition is not a process of taking fire from contact with the pipes, but occurs by absorption of oxygen in cooling, it will readily be seen why a sudden draft of comparatively cool outside air, directed upon heated sawdust which has attained the proper absorptive condition, will produce fire, and also how fire can originate spontaneously in the same sawdust in the course of slower cooling. The pyrophoric stage is not absolutely required to produce this result.

Accumulations of sawdust about joints of pipes where there is a slight leakage of steam are especially hazardous, since alternate moisture and drying both accelerate and intensify this process. Enclosure also has a definite effect, and cases have been observed where a protracted exposure to 212° F. has resulted in ignition and complete combustion. In these very extreme cases, however, the exclusion of external air which contributes to producing this effect may be so complete that the fire extinguishes itself for lack of oxygen.

(2) By moisture:

Sawdust in the mass is prone to heat if green and sappy or damp, this heating at times resulting in ignition. There are two methods by which this result is accomplished:

Fermentation.—All organic compounds containing large volumes of cellulose and lignose, when damp and deprived of ventilation under moderate temperatures, are subject to a form of bacterial fermentation. More water is thus produced, the material about the seat of fermentation gradually blackens, giving off some light vapors, and the temperature slowly rises, followed at the last by a sudden rise and ignition. Hay, straw and other allied substances ignite spontaneously in this manner, but in all cases a fairly abundant supply of oxygen at the last appears essential and the process, apparently, is a rapid absorption of that gas.

Decomposition and Putrefaction.—In this event phosphorous compounds are formed, one of which is phosphoretted hydrogen in the liquid form, which on reaching the air ignites spontaneously. In this event the heat does not normally reach the point attained by fermentation and is not dangerous as simple heat. (Possibly this is the method of spontaneous ignition of ice houses.)

Sawdust containing an admixture of animal excrement is likely to putrefy more rapidly with the evolution of much phosphoretted hydrogen, and even where this is produced at first in the comparatively harmless solid and gaseous forms the mixture of excrement may result in the production of nitrous acid which speedily acts upon the two substances and produces the dangerous liquid form.

(3) From Extraneous Matter.—This is a third kind of spontaneous combustion more dangerous than the others because of its greater frequency and shorter period of incubation.

This is the direct result of covering with sawdust a little oxidizing oil or some bit of oily rags or waste, either of which will suffice. Often a little oil thrown from a bearing into a growing heap of sawdust on a beam has proved enough. In one instance five fires in a shavings vault within as many weeks were the result of workmen throwing bits of used waste into the blower exhaust pipes to avoid the trouble of carrying them to a waste can.

For this kind of combustion the sawdust pile offers ideal conditions. There is just enough air for the purpose, and the insulating qualities of the pile are such that there is practically no escape for the heat of oxidation, which is consequently retained and accumulates until the point of ignition is reached.

Such fires in the interior of a pile proceed by a process of cysting; that is, there will be found a nucleus of combustion, surrounded by a shell of swelled and carbonized material which is more completely nonconducting than the unaltered sawdust. This shell gradually grows by combustion within and extension of the carbonized material outwardly until it reaches the air or because of the size of the cavity and the weakness of the shell it collapses, the result in either case being admission of air and active combustion. It is a "burrowing" fire.

Up to the time the crust is broken only a very little pungent vapor is emitted, the vapors mostly being expelled moisture and hydro-carbon vapors. These are almost invisible and very much lighter than air, in which they rise rapidly with little diffusion. Such an incipient fire, if located five feet or more above the floor, may smoulder undiscovered for days and finally break out after attaining very dangerous magnitude. Detection of these fires is difficult.

There is no remedy for this except scrupulous attention to cleaning up even small accumulations at frequent intervals, with especial attention to bearings, saw arbors and all flat spaces, beams and the like, particularly above the 5-foot level.

Method of Burning.

Sawdust in mass is only superficially flammable. Flame passes rapidly over the exposed surfaces and quickly subsides to a glowing, smouldering form, burrowing deeply and emitting very little smoke, as a rule, but much pungent vapor and gas.

This is due to the structure of the pile, the grains, however compacted, never being sufficiently compressed to avoid the inclusion of much air, which circulates very slowly. This is true of all sawdust, whether compressed or in loose piles, the difference being only in degree.

Wood is a poor conductor of heat (oak rates at 8 in heat conductivity as compared with 5,000 for cast-iron), but even substances of high inherent conducting and radiating power (glass wool, mineral wool, asbestos), when arranged in an analogous manner and enclosing numerous minute volumes of air circulating very slowly, become excellent insulators. None are as good in that respect as sawdust, but they are incombustible, which is usually a prime requisite.

Use of Sawdust as an Insulator.

It is needless to repeat that sawdust should never be used as an insulator about steam or hot water pipes, whether the steam be direct or exhaust.

When used about permanently cold pipes as a protection from frost, the hazard is that of possible putrefaction or fermentation.

It is practically impossible to keep the sawdust dry, for even if there be no leakage or seepage about joints there will be some condensation, which will be greedily absorbed. Accidents from this cause have been very rare and "suspected" rather than "proven," the redeeming feature being the moderate volume of material used.

Conditions where sawdust is used for filler in the hollow walls of ice houses, on the contrary, favor putrefaction, and to a large extent (due to form of construction and ordinary proximity to railroad tracks) impose a considerable spark hazard, especially where there is a mixture of shredded or fibrous material, such as dead leaves and the like. Of these, however, the danger arising from putrefaction, both in the filler and the packing sawdust within the house, is probably the greater. Spontaneous combustion in this class is very frequent, and no other plausible explanation has as yet been adduced.

Chemical Combustion.

Sawdust takes fire at once in contact with strong nitric acid, burning fiercely. If mixed with nitrates (such as saltpetre), it becomes violently explosive like gunpowder. Other mixtures, some chlorates, for instance, have somewhat similar effects. Sawdust should always be kept away from these.

Storage.

Enough has been said to impress the need of certain conditions of safety. Sawdust should be so kept that it cannot come into contact with or even in close proximity to steam pipes, boiler settings, chimneys or stacks. It must be clean and free from any suspicion of oil, foreign matter and waste or dampness (the drier, if air dried, the better). Kiln dried sawdust requires very close watching for at least a week, and there should be adequate ventilation and complete protection from wet.

It is generally recommended that where this material is stored under cover in piles, that these be so arranged as to neither be in contact with one another, nor enclose any parts or vertical supports of the building. Seven feet in height is generally suggested as the limit (a pile 7 feet high and 10 feet diameter at base will contain about 300 cubic feet, 1,450 pounds). Small and rather shallow bins are considered desirable where bin storage is used.

Probably the very best form of building for storage is entirely open on one side or more for complete ventilation, but in any event close care and watching are required.

In cases where the turnover is rapid the restrictions as to size of piles in bins can be considerably relaxed, provided there is no spark hazard or danger of mixture with oil or oily rags.

The process of combustion by fermentation or putrefaction is slow, and if the stock does not remain over three or four weeks in piles or bins and is completely changed within that period, the size of piles or bins can be increased, but this increase is undesirable for green or sappy material. There should, however, be no relaxation of care in exclusion of dampness or reduction in ventilation.

Extinguishing Fire in Sawdust.

Turning a high-powered stream directly upon a burning sawdust pile is to be avoided wherever possible. If the stream is of large diameter it may simply serve to scatter the burning material; if of small diameter the stream may penetrate into the burning interior and the resulting steam explosions be even more effective in scattering coals.

Where possible, it should be applied in volume from above and as gently as possible, directing the stream against some obstacle that will break it up and permit it to merely fall upon the fire. Where practicable, a spray should be used. (The action of automatic sprinklers upon burning sawdust is ideal.)

When water is thrown or dripped upon a pile of sawdust it is at first quickly absorbed by the superficially exposed portion, at once expanding the granules and forming a crust that is only slowly pervious and which will shed water almost completely if applied in large volume. It is a fairly difficult matter to wet a sawdust pile throughout, requiring slow and continuous application, for at every point the swelling material offers an impediment and there is strenuous resistance on the part of the imprisoned air (which, as we know, circulates but slowly at best) to expulsion; nevertheless, in order to completely saturate the mass, the greater portion of the air must be expelled and replaced.

Hazards in Special Processes.

Distillation for Alcohol. The general hazards are the same as in any similar distilling processes: (1) those depending upon the use of sawdust arising from careless handling and scattering of material on its way to the stills, involving spark hazards mainly, (2) those of storage in quantity, and (3) the specially hazardous nature of the carbonized residue during and for some time subsequent to cooling. The carbon of this residue is "pyrophoric" and disposed to sufficiently rapid absorption of oxygen to set up self-ignition, requiring very careful handling and attention.

In Woodworkers. In general, the hazards are those incident to use for fuel, and carelessness. There are no hazards incident to handling and storage, care and removal, that are not always encountered to some extent in this class of manufacture.

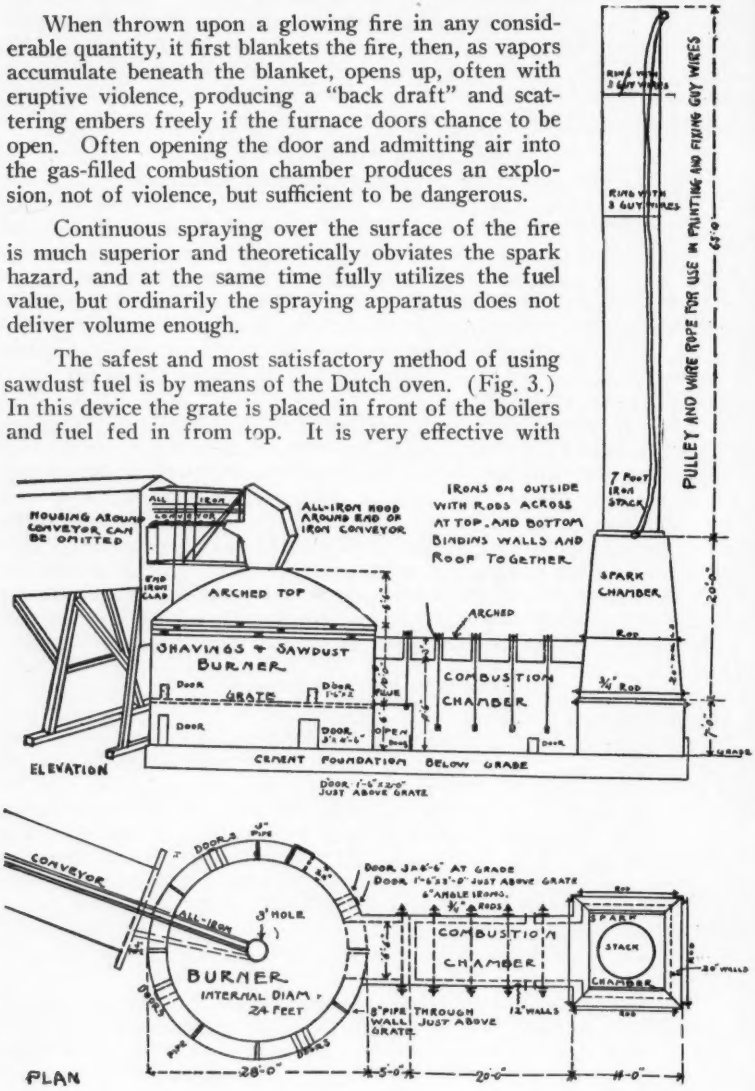
Sawdust Baling. This is often conducted on a considerable scale, involving an addition to storage hazards that of an excessive amount of sawdust about floors exposed to sparks and similar accident. The spontaneous ignition hazard is much in evidence unless well cared for.

Use as Fuel. Although sawdust alone is not a wholly satisfactory fuel, and is generally used as far as possible in combination with coal or heavy wood refuse, it affords a means of utilizing a waste material, and often constitutes to all intents the sole fuel used.

When thrown upon a glowing fire in any considerable quantity, it first blankets the fire, then, as vapors accumulate beneath the blanket, opens up, often with eruptive violence, producing a "back draft" and scattering embers freely if the furnace doors chance to be open. Often opening the door and admitting air into the gas-filled combustion chamber produces an explosion, not of violence, but sufficient to be dangerous.

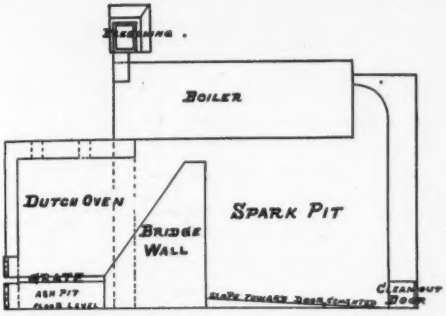
Continuous spraying over the surface of the fire is much superior and theoretically obviates the spark hazard, and at the same time fully utilizes the fuel value, but ordinarily the spraying apparatus does not deliver volume enough.

The safest and most satisfactory method of using sawdust fuel is by means of the Dutch oven. (Fig. 3.) In this device the grate is placed in front of the boilers and fuel fed in from top. It is very effective with



Courtesy Lumber Mutual Fire Insurance Co.

Fig. 2. Properly Constructed Refuse Burner will not emit sparks.



Courtesy Lumber Mutual Fire Insurance Co.

Fig. 3. Dutch Oven using sawdust as fuel.

damp fuel. A reference to the cut will indicate that this is in fact a system of continuous dry distillation, the gases passing into the combustion chamber and burning there while the entire residue is used to continue the distilling process. The fuel value is almost completely realized.

Other hazards we may trace to the condition of the fire room floor and vault construction (if there is a storage vault). Where a number of charges are drawn and remain upon the floor in front of the furnace, there exists a strong spark hazard which only vigilance on the part of the fireman can control. The vault has some hazards of its own. Sawdust in motion over conveyors or blown through pipes produces considerable fine dust by attrition. This fine dust, which has a tendency to separate from the mass and be deposited as a "fur" on walls, is violently explosive when mixed with air, and is apt to settle heavily upon all flat surfaces. These accumulations, when dislodged by their own growing weight or some shock, produce a cloud of dust-laden air that is highly explosive and, if reached by a spark, a disaster is almost unavoidable.

Shavings and sawdust vaults should, if possible, be constructed with the withdrawal doors opening at a right angle to boiler front if within 10 feet of furnaces, and always with the bottom of the door not less than 18 inches above the boiler room floor, in order that fire, "crawling" in any refuse on floor, may not communicate to vault contents. A good fire door is, of course, a requisite.

The spark-producing qualities are well known, but of sawdust alone are not so severe, being more generally the result of burning shavings. Proper spark-arresting devices can largely control this hazard.

Other Disposal. In many cases there is a large surplus of sawdust beyond what can be used for fuel, and conditions do not render any economic use practicable.

In the days when the lumbering industry was at its height in the Central States, this surplus was largely used for filling low ground, and upon this foundation towns and cities were built. The "sawdust town" was a by-word, and disaster followed disaster in swift succession—even experience failing to deter. Oshkosh, Wisconsin, burned several times, as did other similar towns. The author distinctly remembers leaving a train in a "sawdust town" in the early morning for breakfast at an uptown hotel—the breakfast was never finished and the train was regained only at a point on the outskirts and by a long detour. Underground fires in this filled ground have at times extended over large areas and, breaking out in unexpected places, caused extensive damage.

Sawdust is unsafe as a filler, even when covered with several feet of sand or earth. It gives off vapor of more or less hazard as it decays, but even dumping it as a filler for low ground may be preferable to leaving unattended piles to decay or ferment in slashings or similar places.

Refuse Burners. These constitute another means of disposal. If properly built they involve little hazard and, other than for the destruction of material which could better be put to economic use, are not particularly objectionable. (Fig. 2.)

General Use as Absorbent, Dust Allayer. Storage for this purpose is usually in small quantities and of brief duration, and if properly safeguarded from sparks or flame and the introduction of material spontaneously combustible, or oil, involves little hazard, provided that, in each and every case, the used material is promptly removed and destroyed at brief intervals, preferably daily. For use as an absorbent about oil cans its use should be completely forbidden, especially about volatile oils like gasoline, where it not only increases the production of explosive vapor by providing a greater evaporating surface, but also increases the hazard by absorbing and holding a surplus that otherwisé would run away. For that reason the use of sawdust about diptanks and the like is subject to emphatic condemnation. It has been productive of many accidents and much damage when so used.

The General Record.

As a whole, fires due to the sawdust hazard form a distressingly large part of the total. It is difficult to separate those due to simple carelessness and ignorance from those due to inadequate methods of handling, storage and use.

We can justly say, however, that an extremely large proportion of fire having origin in sawdust in any form belong in the "preventable" class, and are almost without exception avoidable by proper and reasonable care and understanding. We may hopefully look to a diminution of that percentage we now regard as due to unavoidable conditions in proportion to the development of economic use and value as raw material. It must not be assumed that decomposition and spontaneous ignition occur only in material under cover. Many cases are reported of the spontaneous ignition of sawdust piles in the open, and there is a reasonable probability that many destructive fires starting in slashings have their origin in the abandoned piles of sawdust.

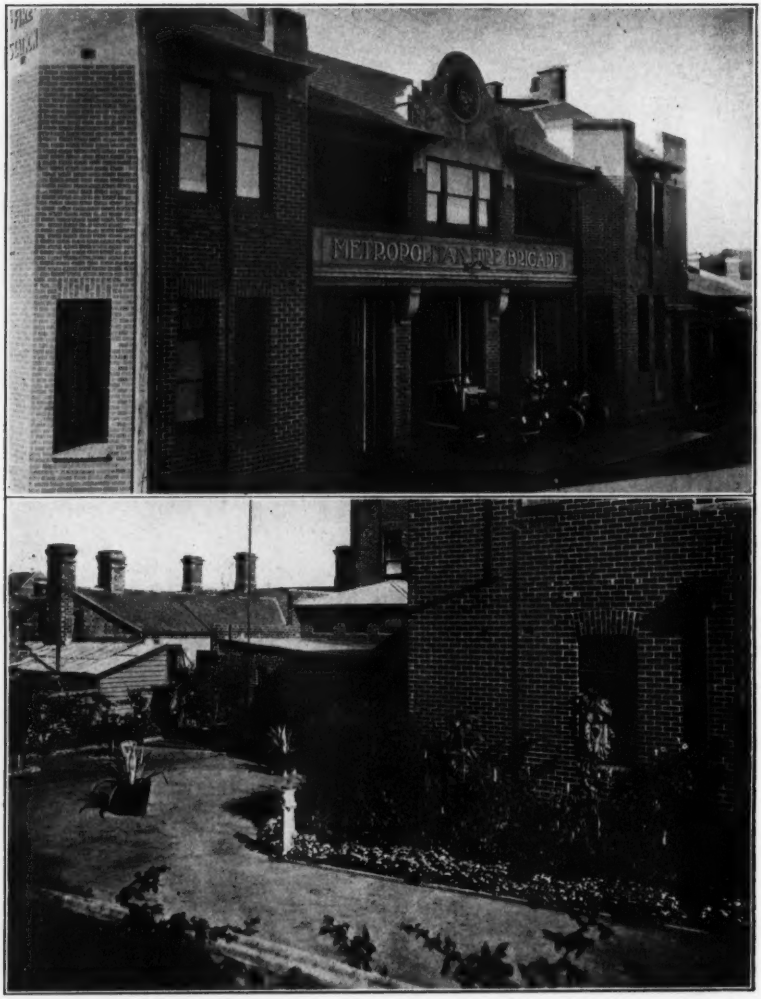
NEW NO. 2 FIRE STATION, WILLIAMS STREET, MELBOURNE, AUSTRALIA.
This home-like station has comfortable separate living quarters for twelve firemen and their families

Fire Houses in Australia.

The welfare of fire department personnel receives an attention in Australia far beyond anything seen in the United States and Canada, where the comfort and living conditions of the firemen have commonly been given comparatively little consideration. Our member, Mr. Harrie B. Lee, chief officer of the Metropolitan Fire Brigade, Melbourne, Australia, has given a concrete example of what can be done in his report and in the photographs which are reproduced here.

Married firemen live with their families either in the fire station itself or in separate cottages immediately adjacent. Melbourne's new No. 2 Fire Station makes comfortable provision for twelve married men and their families, all under the same roof, as well as providing quarters for single men, and recreation rooms for general use. The photograph is a front view of this station, and shows the two entrances to the living quarters at the sides, entirely separate from the doors of the station proper where the motor apparatus is standing. Mr. H. Heydon, third officer of the Melbourne Fire Brigade, describes this station as follows:

The building is three storeys and constructed of brick and concrete. It contains twelve sets of quarters, six having four rooms, four having three rooms, and the remaining two five rooms. There are also four cubicles for the use of the single men. The whole receives ample daylight from two light areas. Each set of quarters has its private entrance, there being a passageway on both sides of the station, each common to six sets of quarters. Entrance to the several quarters is



SOUTH YARRA FIRE STATION, MELBOURNE, AUSTRALIA.

Upper Picture shows fire house accommodating three firemen and their families. Lower picture is rear view of the same building, showing garden and separate firemen's cottages in the background.

by way of staircases. This arrangement allows visitors to reach the men's homes without in any way trespassing on the station proper. To enable the men to turn out smartly, each set of quarters has a door which opens on to a gangway leading to poles, down which the men slide to the ground floor immediately behind the engine room.

The whole of the quarters are equipped with the most modern conveniences; all kitchen and other refuse is deposited in air-tight bins, the contents being burned in the furnace connected with the heating apparatus.

We house in this station seventeen men—twelve married and five single; in all forty-five souls, including women and children.

Another station, the South Yarra, has accommodations for a smaller number of families in the fire house, but being located outside of the congested value district has space adjacent to the station for individual cottages for the firemen. These cottages are owned by the men. The photographs are front and rear views of this station. Quarters are provided in the station building for one officer and two firemen, with their respective families.

The arrangements made by the Melbourne Fire Department for checking up the efficiency of watchmen will be of interest. Quoting again from Mr. Heydon's letter:

It may be of interest to know that in addition to our numerous street alarm circuits we have about forty direct lines to various important buildings, such as the Government Stamp Offices, King's Warehouse, where the materials for the manufacture of notes, money orders, etc., are stored, and many private firms. In most of these premises a watchman's clock system is installed. All being well and the watchman doing his duty, we are not troubled, but should the watchman fail, then we are at once automatically notified of the fact by that particular circuit opening. We immediately ring him, and failing to get an answer we turn out a motor hose carriage to enquire as to the reason. A similar device is in operation in the watch-room at the station. This has a five-minute check with a one-minute warning bell. Should the duty man neglect to press the button, which is conveniently situated on the switchboard, within six minutes, a general alarm is rung through the building, when the whole staff turns out and the reason for the neglect of duty is ascertained.

Labor and Fire Peril.

By the Editor of the Bricklayer, Mason and Plasterer.

There is one aspect of the relations between labor and capital which has received too little attention: it is that relating to fire peril. Industrial fires in the United States are more frequent and more serious than is generally realized. Not only do they make up the largest portion of the total fire loss, since the average industrial fire will outweigh in damage a number of fires in dwellings, but they also include a shocking total of fatalities. These fatalities, of course, are almost entirely among the workers. The question of industrial fire peril thus becomes of vital importance to labor. Indeed, it is one of the subjects which labor organizations may well take up for serious consideration. It also is one of the subjects to which industrial and trade organizations may well accord quite as serious consideration. The viewpoint is opposite, but the interest is mutual.

Labor Risks Its Life.

Labor risks its life when working under hazardous conditions. It can and should insist that premises be made as safe as conditions will permit. On the other hand, labor itself furnishes one of the chief causes of industrial fires. The ignorant or careless workman is a hazard to his fellows as well as to the plant in which he is engaged.

Labor thus has its plain rights in the matter of fire protection and its direct responsibility in the lessening of fire causes. One phase is physical, the other psychological, but both are essential.

The manufacturer, too, must not consider solely the financial aspect of industrial fires. It is even more important that he realize to what a great extent the lives of the operatives are dependent upon his care and oversight. He should never wait until compelled to make improvements; rather, he should take the lead in assuring to his workers the safety which they have the right to expect.

This article purposes a brief survey of the situation from both viewpoints. Its main purpose is to invite co-operation from both manufacturing and labor organizations in lessening the fire hazard in industrial plants.

Industrial fires, like all others in which damage occurs, involve two factors, namely, the conditions which permit the flames to spread, and the original causes. In the first of these, the management is usually responsible; in the second, labor bears a large part. All told, the responsibility of the manufacturer outweighs that of the workman and should be considered first.

The Employer's Part.

Workers, when they have been assembled for any industrial enterprise, come into premises already prepared to receive them and about which they, for the most part, have had nothing to say. It is not to be expected that the average workman can have knowledge of fire prevention engineering, and he thus may be subjected to hazards of which he has no thought prior to the moment of disaster.

With the present understanding of fire and its laws of origin and spread, the manufacturer, however, has no right to plead such ignorance. It is clearly his responsibility to see that the building in which many human beings are expected to spend a number of hours each day be as thoroughly safeguarded from fire peril as it is possible to make it. An altogether amazing proportion of the industrial plants now in use are little short of fire traps, some of them of the most atrocious character. The word "trap" suggests inability to escape, and there have been numerous instances where exactly this fact has been responsible for the loss of life.

Labor's Part.

Without doubt the owner has a greater load of responsibility than the worker in establishing safeguards against fire. Labor's connection with the problem of fire prevention, however, while wholly a matter of personal conduct, is nevertheless of extreme importance. No matter how many precautions a factory owner may install in his plant, his safeguards are largely set at naught if he has in his employ many careless, irresponsible workers who will not observe rules and regulations.

In the present industrial era a workman is largely a specialist in one particular step in the course of production, but each man should take heed of the hazards of his special field. Even where the fire dangers are obvious, they should be impressed upon the workers.

The rule against smoking is one of the utmost importance and should be rigidly adhered to. Too often, unfortunately, this prohibition is more honored in the breach than in the observance, as fire statistics so conclusively show. If the workman realized how often the act of smoking is the cause of fire, he would think twice before indulging in the habit.

As indicated by the foregoing, both the owner and the employe have their parts to play in preventing the destruction of our industrial organization by fire. Increased production was never more important to the country than it is today, and one of the most certain ways to make larger output possible is to preserve existing plants intact.

The current wave of discontent is due largely to the fact that demand has so far outrun supply that prices for necessities stretch the public purse until it groans for relief. A way to hasten this relief has been pointed out. Thus the man who consistently endeavors to prevent the destruction of lives and property by fire not only performs a service for his community, but one for his country, too.

Workmen as Fire Wardens.

By the Hammermill Paper Company.

"Where's the fire alarm box?"

Joe stole a fleeting glance around the room before answering the superintendent's sudden question.

A quiet questioning of other men in the shop demonstrated that although several thousand dollars had been spent during the year for new fire-fighting appliances, not a man in ten knew where they were. Those who did know had their information because the apparatus was near their bench—"in the way," some of them expressed it.

Similar situations undoubtedly exist in other American concerns. The loss from fire has become so enormous—it amounted to over $250,000,000 last year—that it is hard to find a shop or store not provided in some way or other with fire-fighting apparatus. Too often, however, the human side of the problem is overlooked. Protection is considered complete when apparatus is installed and a fire brigade is organized. There is a tendency to overlook the fact that the best time to fight a fire is before the fire department arrives, and that just a little time spent in drill and instruction will make *all* the workers efficient guardians of a valuable property.

Many ways are in use to enlist the workers against this common enemy. Among the most efficient is the plan of appointing new fire inspectors weekly from among the men and securing their assistance in checking up on the watchman and others whose duty it is to keep an eye open for fire dangers. It is a fact that paid watchers do go stale. A new man on the job to check them up is often sufficient urge to make them keep their eyes open.

The Fire Inspector's report illustrated here was designed to fit just such conditions. Every Monday each foreman calls one of his workmen from his bench, hands him the report, tells him to find fire hazards if he can, and then fill out the report in duplicate. The original report, in white, goes to the foreman; and the duplicate, in any color, is sent to the assistant superintendent, who checks up on the recommendations which are offered.

Although valuable suggestions for reducing fire risk are frequently offered by the amateur inspectors, who generally enjoy their work, a more subtle purpose is achieved. It is highly effective in securing the co-operation of the workers. In answering the questions, which are simple enough, the inspector familiarizes himself with the exact location of the various preventives. And it's a strange workman that won't take the boss's time to read the directions for the use of appliances while he is on the job. Also writing down the location of the appliances helps him to remember them. And the men like the brief authority that the

FIRE INSPECTOR'S REPORT

Dep't. Date 6/22 19

FIRE EXTINGUISHERS READY FOR USE? yes LOCATION? West wall.

FIRE ALARM WORKING? yes LOCATION? Door 3

SHAFTS, AREAS, CORNERS FREE FROM RUBBISH? yes

HOSE IN GOOD CONDITION? Nozzle on reel 1 caked LOCATION? At stairway

FIRE ESCAPES CLEAR? yes EASY TO USE? yes LOCATION? East window

FIRE DOORS WORKING? yes

FIRE BUCKETS AND BARRELS FILLED? yes

ANY SMOKING ON PREMISES? No

FIRE WARNINGS POSTED? yes

EXIT SIGNS IN PLACE? yes

STAIRWAYS CLEAR? yes

STEAM PIPES FREE OF CLOTHING OR RUBBISH? yes

AXES AND OTHER EQUIPMENT IN PLACE? yes

WATCHMAN'S STATIONS CLEAR? yes

BURNED MATCHES ANYWHERE? In wash room

ELECTRIC LIGHT CORDS CLEAR OF METALLIC OBSTRUCTIONS? yes

SAND TRUCKS FILLED? yes SHOVELS IN PLACE? one shovel gone

SPRINKLER SHUT-OFF CLEAR? yes LOCATION? At elevator

REPORT ANY POINTS NEEDING ATTENTION NOT CLASSIFIED ABOVE:

Pile of oily waste under bench in chipping room

SIGNED J. M. Daley FIRE INSPECTOR

fire inspector's job carries with it, for while they are in office the responsibility of fire protection for the department rests in their hands.

It is amazing at times to find what a change of inspectors will show. For example, the man who made out the report which is illustrated found that the nozzle on one of the hoses had become caked hard with dirt and grease. Probably in case of fire in the department the hose would have been useless for valuable minutes. Notwithstanding this discovery, the hose had been inspected every week, but no one had thought to examine the metal nozzle. Frequently waste and rubbish is discovered in unexpected places. Then the assistant superintendent makes the report a text for a bulletin commending the inspector for his thoroughness and warning of the dangers that disorderly habits create.

Also scattered through the report are reminders of the underwriters' rules. By reporting that the stairways, passages and fire escapes are clear, the repeated warning not to obstruct them is brought forcibly to mind. Looking for rubbish and waste in unexpected places makes the inspector think of using the receptacles provided for the purpose. Cautions against smoking are made more effective. Other questions, such as "Clothing on Steampipes?" awaken memories of how often a little thoughtlessness has started a big fire. The report also helps to improve the tidiness of the plant.

Simple as the report is, its effectiveness has been marked wherever it has been used. Some concerns offer a bonus to any employee making an accepted fire prevention suggestion, but often this incentive to duty is not necessary. The responsibility on the inspector is almost always great enough to key him up to making every effort to find violations overlooked by his predecessors.

When the report is used, fire hazards will be sought from a fresh point of view and found by the score at first. Later, as all the men have opportunity to view the plant, or their department at least, through the eyes of a fire inspector, they will insensibly take a personal interest in observing rules drawn up for their own good.

This is only one example of the way in which a simple form—a little printing on a piece of paper—can be of tremendous influence and have results so far-reaching that it is difficult to realize their simple source in a simple system.

Comparative Statistics of Fire Loss.

According to the 1920 report of the Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters, the estimated per capita fire loss for the United States for 1919 is $3.13.

The estimated fire loss in the United States for the past calendar year, taken from the records of the Journal of Commerce, approximates $249,179,275, a decrease of practically $41,000,000, or $2.33 per capita, as compared with $2.76 for the preceding year, a reduction of about 15 per cent.

It is believed that these estimates are entirely too low, and that it is more accurate to use the reports filed with the Actuarial Bureau, adding 25 per cent. to cover losses paid by companies not members of the Bureau and property destroyed which was uninsured. On that basis, there is shown for 1918 a property loss of $350,000,000, or $3.23 per capita, and for 1919 $325,000,000, or $3.13 per capita. In either case, the fire loss record is a serious one when considered solely from the standpoint of economics. No doubt a considerable proportion of the reduction in fire loss is due to the conservation work which has been continued by the companies, as well as by state fire marshals, chief of fire departments and others. With the steady growth in value of constructed property and the increased cost of production, both of which have been above normal, any reduction in the fire loss constitutes a material gain in the conservation

of the nation's resources, as the losses must be compared with the larger exposure created by the increased value and cost of replacement.

The estimated fire loss for Canada for the year 1919 was $23,207,647, and for 1918 $31,815,844, or a decrease in the per capita loss from $4.11 in 1918 to $2.90 for the past year, a reduction of about 27 per cent.

Cities in Which Loss Exceeded $5.00 Per Capita.

1919

*Cedar Rapids, Ia.	$50.41	Mansfield, O.	$7.08
Rock Island, Ill.	27.49	Toledo, O.	6.82
‡Norfolk, Va.	27.23	†Houston, Tex.	6.73
Mobile, Ala.	17.93	Kearny, N. J.	6.68
‡Fresno, Cal.	15.64	Watertown, N. Y.	6.44
†Little Rock, Ark.	14.89	Huntington, W. Va.	6.42
East Chicago, Ind.	14.30	*Hoboken, N. J.	6.35
*Stamford, Conn.	13.09	Lakewood, O.	6.14
Petersburg, Va.	13.08	†Augusta, Ga.	6.12
Great Falls, Mont.	13.00	Butte, Mont.	5.56
Chelsea, Mass.	9.59	*Tulsa, Okla.	5.55
*Somerville, Mass.	8.58	Moline, Ill.	5.45
*Ottumwa, Ia.	8.43	Grand Rapids, Mich.	5.22
‡Dubuque, Ia.	8.37	Sacramento, Cal.	5.10
Tampa, Fla.	7.83	*Fort Smith, Ark.	5.09
Danville, Va.	7.29		

1918

Burlington, Vt.	$21.74	‡Des Moines, Ia.	$7.14
*Fort Smith, Ark.	19.79	Indianapolis, Ind.	7.06
Lima, Ohio	16.52	Pawtucket, R. I.	6.46
Kansas City, Mo.	12.86	Danbury, Conn.	6.45
*Oswego, N. Y.	12.76	Newark, N. J.	6.42
*Port Huron, Mich.	12.18	Findlay, Ohio	6.36
Canton, Ohio	11.33	*Jersey City, N. J.	6.19
‡Fresno, Cal.	10.72	*Wheeling, W. Va.	6.12
*Hoboken, N. J.	10.47	San Antonio, Tex.	6.01
Revere, Mass.	8.76	†Little Rock, Ark.	6.00
Eau Claire, Wis.	8.68	Walla Walla, Wash.	5.91
*Duluth, Minn.	8.52	*Saginaw, Mich.	5.55
Leominster, Mass.	8.23	Chattanooga, Tenn.	5.44
Memphis, Tenn.	7.93	Beaumont, Tex.	5.36
‡Norfolk, Va.	7.72	*Somerville, Mass.	5.26
Johnstown, Pa.	7.71	*Williamsport, Pa.	5.20
Bloomington, Ill.	7.34	*Tulsa, Okla.	5.08
*Charlotte, N. C.	7.34		

1917

Hazelton, Pa.	$14.37	Omaha, Neb.	$6.81
Kansas City, Kan.	11.13	*Charlotte, N. C.	6.74
Lexington, Ky.	11.04	Springfield, O.	6.45
Lynchburg, Va.	10.42	‡Dubuque, Ia.	6.31
Albany, N. Y.	9.99	‡Fresno, Cal.	6.09
*Wheeling, W. Va.	9.58	†Augusta, Ga.	5.92
‡Des Moines, Ia.	9.57	Nashua, N. H.	5.91
*Erie, Pa.	9.31	*Chicopee, Mass.	5.88
*Saginaw, Mich.	9.02	Council Bluffs, Ia.	5.85
*Stamford, Conn.	7.95	El Paso, Tex.	5.57
*East St. Louis, Ill.	7.91	Paducah, Ky.	5.44
Hartford, Conn.	7.50	Boston, Mass.	5.27
Dallas, Tex.	7.30	†Houston, Tex.	5.14
Bangor, Me.	7.28	New Rochelle, N. Y.	5.01
‡Norfolk, Va.	6.86		

1916

*Jersey City, N. J.	$27.71	†Houston, Tex.	$6.90
Asheville, N. C.	14.93	*East St. Louis, Ill.	6.28
*Ottumwa, Ia.	12.68	†Little Rock, Ark.	6.27
Green Bay, Wis.	12.08	*Chicopee, Mass.	5.97
‡Dubuque, Ia.	9.12	*Cedar Rapids, Ia.	5.94
Fall River, Mass.	9.09	Portland, Me.	5.87
Shamokin, Pa.	9.07	Amsterdam, N. Y.	5.81
Peoria, Ill.	8.51	*Duluth, Minn.	5.75
‡Norfolk, Va.	8.25	New Castle, Pa.	5.09
Columbia, S. C.	8.10	Spartanburg, S. C.	5.07
Sandusky, Ohio	7.60	Cohoes, N. Y.	5.05
Austin, Tex.	7.43		

1915

Newport News, Va.	$28.00	Danville, Ill.	$6.86
Clinton, Ia.	12.46	Joliet, Ill.	6.83
†Augusta, Ga.	11.87	Galveston, Tex.	6.52
Raleigh, N. C.	10.37	Springfield, Ill.	6.47
Key West, Fla.	9.41	‡Fresno, Cal.	6.24
Lockport, N. Y.	9.31	*Port Huron, Mich.	6.06
Muncie, Ind.	9.16	Salem, Mass.	5.85
Davenport, Ia.	8.80	Muskegon, Mich.	5.57
Trenton, N. J.	8.11	*Williamsport, Pa.	5.48
*Erie, Pa.	7.78	‡Dubuque, Ia.	5.35
Shreveport, La.	7.64	Burlington, Ia.	5.14
Wilkinsburg, Pa.	7.50	*Oswego, N. Y.	5.14
Montgomery, Ala.	6.94		

* These cities in this class in two of the five years.
† In this class three of the five years.
‡ In this class four of the five years.

Annual Fire Losses in the United States for Forty-Five Years—1875-1919 Inclusive.*

YEAR.	AGGREGATE PROPERTY LOSS.	YEAR.	AGGREGATE PROPERTY LOSS.
1875	$ 78,102,285	1897	$116,354,575
1876	64,630,600	1898	130,593,905
1877	68,265,800	1899	153,597,830
1878	64,315,900	1900	160,929,805
1879	77,703,700	1901	165,817,810
1880	74,643,400	1902	161,078,040
1881	81,280,900	1903	145,302,155
1882	84,505,024	1904	229,198,050
1883	100,149,228	1905	165,221,650
1884	110,008,611	1906	518,611,800
1885	102,818,796	1907	215,084,709
1886	104,924,750	1908	217,885,850
1887	120,283,055	1909	188,705,150
1888	110,885,665	1910	214,003,300
1889	123,046,833	1911	217,004,575
1890	108,993,792	1912	206,438,900
1891	143,764,967	1913	203,763,550
1892	151,516,098	1914	221,439,350
1893	167,544,370	1915	172,033,200
1894	140,006,484	1916	214,530,995
1895	142,110,233	1917	250,753,640
1896	118,737,420	1918	290,959,885
		1919	249,179,275

* These figures are obtained from the Records of the Journal of Commerce, deducting the Canadian losses.

Comparative Fire Losses.

	Population	Total Loss	Per Capita
1915—Whole country	100,399,318	*172,033,200	1.71
333 cities	35,161,266	† 68,386,218	1.94
1916—Whole country	102,017,312	*214,530,995	2.10
329 cities	36,055,568	† 79,440,658	2.20
1917—Whole country	103,635,606	*250,753,640	2.42
327 cities	36,557,011	† 89,483,398	2.45
1918—Whole country	105,253,300	*290,959,885	2.76
328 cities	38,079,781	† 95,365,412	2.50
1919—Whole country	106,871,294	*249,179,275	2.33
326 cities	39,898,869	†103,028,235	2.58

* Estimated. † Actual figures reported.

City Taxes for Fire Protection.

By R. O. Wynne-Roberts.

(Toronto.)

Many suggestions have been advanced from time to time as to how best to reduce the huge fire losses in North America. It is not proposed now to discuss the many proposals, since they have often been critcized, condemned, approved, rejected or adopted according to their practical merits. But there is one suggestion that, so far as the writer is aware, has not received much consideration, and that is, the city authorities should assess the owners of property for fire protection according to the risks involved. This is, of course, a radical proposal, but public service should be paid for on a fair and definite basis. The present method of assessing owners for public service does not appear to be equitable; it tends to discriminate against the owners of properties which are substantially built, thereby creating an inducement for the erection of cheap and hazardous structures.

Before proceeding further, it may be said that fire risks are largely due to the methods of construction. In other words, a reinforced concrete structure will create less fire hazard than a timber-framed one under similar conditions of use, location and environment. The fire insurance companies offer better terms to the former than to the latter, and in this way the owners of the substantial buildings now derive some advantage. The cost of erecting a fire-resistive building may be considerably more than that of a timber-framed structure; it will be a valuable asset to the city assessor; it may afford employment to men and women under conditions of minimum fire dangers; or it may be a respectable dwelling in which every care has been taken in the design and selection of materials. We know of instances where such buildings have been erected affording satisfaction and pride to the owners, only to be endangered by the erection of cheaper and hazardous structures adjoining.

The city assessor will view the substantial building with approving eyes because it is more valuable, and since the owner is a prosperous, enterprising man, he can easily stand for more taxes. Thus the two

examples suggest to us that under the present method of taxation he who builds well must pay more. It is obvious that further municipal assessments and taxations along this line are not conducive to better building nor to a reduction of the enormous annual fire losses.

Municipal taxes, *inter alia*, include the cost of fire brigades, which organizations are essential for public safety. These taxes are levied on properties in proportion to their assessed values, consequently the fire brigade service is charged likewise. The first-class building which possesses a minimum of fire risks, but costs more to build, is punished by high taxation; while the cheap erections, which cost less and are assessed lower, are taxed less, despite the fact that the fire brigade services available are rendered in the reverse order. Let us carry the analysis still further. Some cities charge the Fire Department with rental for hydrants and others charge for water, both of which are in greater demand to extinguish fires in cheaper buildings.

One of the primary functions of a water system is to provide water for fire extinguishment. If these systems were divided into two departments, one for domestic and industrial supply, and the other for fire purposes, it would be found that the respective capacities of each would be roughly as follows:

In cities of 10,000 population, 17% domestic use 83% fire purposes
In cities of 50,000 population, 46% domestic use 54% fire purposes
In cities of 100,000 population, 63% domestic use 37% fire purposes
In cities of 200,000 population, 81% domestic use 19% fire purposes
In cities of 300,000 population, 91% domestic use 9% fire purposes

The cost of the systems divided as above would be:

In cities of 10,000 population, 40% domestic use 60% fire purposes
In cities of 50,000 population, 68% domestic use 32% fire purposes
In cities of 100,000 population, 77% domestic use 23% fire purposes
In cities of 300,000 population, 87% domestic use 13% fire purposes

These figures are extracted from a valuable and instructive report by three well-known American engineers.

If a charge is made by the Water Department against the Fire Department for water and readiness to serve, it is then included in the general taxes already referred to. This further aggravates the injustice to the builder of the good structure and acts as soothing palliative to the man who erects a poor one. It would seem that our method of taxation was contrived for the purpose of encouraging the erection of combustible buildings.

Supposing that city authorities were to charge for fire brigade and water services in proportion to the hazards involved, it would not be a difficult task to anticipate the effect. Fire insurance companies base their rates upon the hazards involved, and it will be admitted that this fact has tended toward a great improvement in building construction. This is an argument for the extension of the same principles to municipal financing. If taxes for fire prevention were levied according to a scale of hazards of different types of construction and established by surrounding conditions, it would not be long before builders and owners would carefully study the economics of building construction. Differential taxation for fire protection would act as a deterrent against poor construction; it would

depress the selling value of inferior buildings and increase that of superior ones; it would in time diminish the cost of fire protection as the causes of fires are reduced; it would cut the losses due to fires and thereby conserve our wealth; it would save life and reduce unemployment caused by serious conflagrations; and finally it would reduce the cost of fire insurance. This may be too sanguine a prospect. It is, however, one which deserves our attention. Those who have studied building construction, and the relative fire hazards and losses in Europe and America, must be impressed with the importance of the great question now under consideration.

Fire insurance companies are not exactly benevolent institutions; they are business organizations which are prepared to carry risks at a price. Excessive losses due to large fires must be recouped by increased rates, and reduced losses will likewise in time have the effect of reducing the rates. Fire insurance companies and civic authorities co-operating on the above lines would soon effect a change, for it is only human to consider the financial obligations and benefits of a building scheme ahead of its ethical aspects. If owners found it financially advantageous to abandon the old structure for a newer and better one, it would not be long before they would act accordingly.

Making Wood Fire Resistant with Paint.

By Forest Products Laboratory, U. S. Forest Service.

Fire-retardent paints are the most practical means so far discovered by the Forest Products Laboratory by which small amounts of wood can economically be made fire-resistant. The only other known methods of decreasing the inflammability of wood are to keep it wet or to inject into it certain chemicals under pressure. These methods, though more effective than painting, are usually either impracticable or too expensive to be considered.

Ordinary calcimine or whitewash has proved in tests to be as fire-sistant as any paint covering tried. It is cheap and convenient to use. Although it will not prevent the burning of wood exposed continuously to a high heat, a good coat of calcimine on wood will decrease the danger of a blaze spreading from burning cigarettes, sparks, matches and similar small sources of fire. Calcimine is, of course, more effective for inside than for outside use.

For exterior use, numerous patented fire-retardent paints are available. An effective outdoor paint which has been developed at the Forest Products Laboratory consists of linseed oil, zinc borate, and chrome green. This paint has maintained its fire-resisting properties through more than three years of exposure to the weather.

"Best Building" Competitions in Cleveland, Ohio.

In 1917 the Cleveland Chamber of Commerce, through its City Plan Committee, inaugurated a "Best Building" competition. Readers of the January, 1919, QUARTERLY will remember that the award of a medal, taking the form of a tablet to be affixed to the building, is intended to call attention to good examples, and thus foster future construction along the right lines. The awards are made by a competent representative jury, which considers and gives due weight to such factors as aesthetic value, adaptation of space to use, sanitation and fire safety.

The remarkable feature of the Cleveland building competition is the high standard maintained by the juries. When no building worthy of an award has been found, the standard has not been lowered to accommodate some structure which, while the best constructed during the year, is still only "almost good."

Three classes of buildings are included, Apartment Houses, Factories and Commercial buildings of three stories or less. In the first three years of the competition, out of a possible nine medal awards, one in each class each year, only five buildings were found of sufficient merit to justify an award. Conditions of the competition emphasize the proper and suitable use of inexpensive materials, and in most cases the awards have been made to small and relatively unpretentious structures.

In the January, 1919, QUARTERLY the reports of the first year of the competition were summarized. Extracts from reports for the years 1918 and 1919 follow.

Jury on Apartment Houses, 1918.

The jury has carefully considered all of the apartments and finds one little building out on East 71st Street, about three or four hundred yards south of Broadway on the east side of the street. The committee is unanimous in their decision that this is the best apartment house completed in 1917. Its merit consists in its good planning, good building. It rents very reasonably, the more important suites for $22 and the majority for $18. There are eight suites, four rooms to a suite. It is of the duplex type, suites being up and down. It has good furnaces, large rear porch with porch above, suitable for attaching awnings and converting into a sleeping porch. The building is very plain, but is well built. While it is not an example of the most excellent architecture, it is built of good material, simple, good brick, and the brick is carried around the side of the building. There are no embellishments on the building. Every room is well lighted, and if the adjacent property were built up absolutely to the line, the house would still have light and air sufficient for its area.

Apartment House, 3855 East Seventy-first Street, awarded a medal as the best building of its class completed during 1917.

Jury on Apartment Houses, 1919.

Very few of the apartments visited were worthy of any consideration. The majority were small, cheaply built and could not be classed as good building. Most of the apartments were of the same type, showing a lack of study in plan, selection of materials, and without any merit as to architectural design.

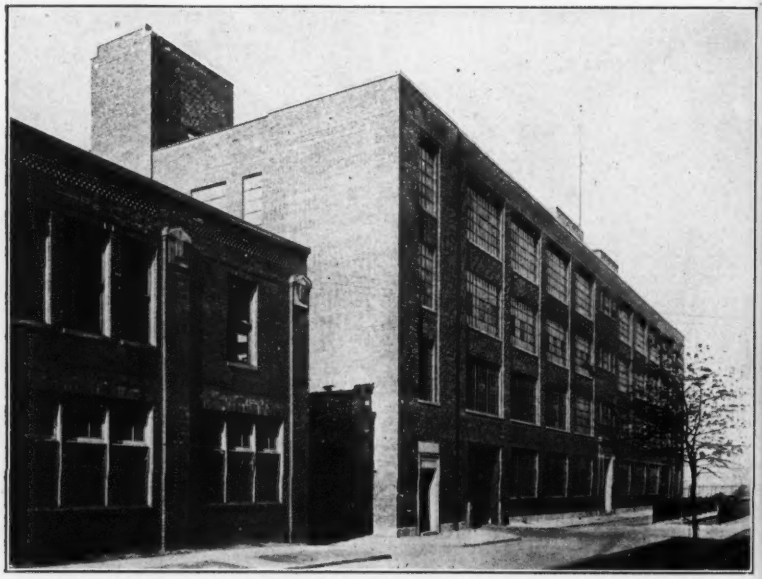
The jury does not feel that any award should be made this year.

Jury on Factory Buildings, 1918.

It is most singular that during a period of extreme activity in the construction of factory buildings during the year 1917, and only exceeded at any time in volume by $50,000 in cost during 1918, no building of sufficient note should have been constructed or completed to warrant your jury on factory buildings to recommend the granting of an award.

We found a number of examples where it was evident that architecture was sought, but in each case the knowledge of the master-mind in the theory of design, however simple, was lacking, and the jury felt constrained to place it among the eligible class, as it was unworthy of the high honor of the medal award.

Some of the structures appeared to be well planned to meet the requirements of the kind of work being done; others were either of fireproof construction or were equipped for safety against fire, were well lighted and ventilated, but very few took into consideration any idea of beauty of site, correlation with other buildings or of future site develop-



Factory Building, Globe Machine and Stamping Co., judged to be best suited to manufacturing uses of any building erected in Cleveland during 1918.

ment. The building was merely placed where it was deemed most advantageous from a commercial point of view.

We believe, however, that greater attention is constantly being given this subject by owners and designers, for the advantages are not obscure and there is a growing realization that environment means much to men, to all classes of men.

The jury believes, too, that the standard should never be lowered to accommodate some structure which might be classed as "almost good," believing that this would be disastrous to the cause which has been so splendidly fostered by the Chamber of Commerce.

The jury therefore regrets that it is unable to find a factory building constructed or completed during the year 1917 sufficiently meritorious to enable it to recommend the medal award for this class of building.

Jury on Factory Buildings, 1919.

The jury appointed to judge the many factories erected during the year 1918 begs to report that, in their judgment, the award should be made to The Globe Machine & Stamping Company for their building erected on West 76th Street.

The building is very complete, is well arranged, of inexpensive materials, and fulfils practically every requirement of a successful and satisfactory factory building.

The Jury on Small Commercial Buildings awarded to this building the medal as the best structure of its kind completed during 1918. Kelly Springfield Tire Co.

The building is fireproof, being constructed of reinforced concrete, with iron stairs, and in addition is equipped with a very complete welfare department for the pleasure and benefit of the employes. The welfare department consists of a club room, a bowling alley and a roof garden with check rooms, retiring rooms, toilets, etc., and is very complete. The whole is furnished in excellent taste and in a manner that shows that the company is not only interested in the physical, but in the social wellbeing of its workers.

Jury on Small Commercial Buildings, 1918.

The jury members personally inspected all of the buildings coming under this division completed during 1917, and were unable to find any building of sufficient architectural merit to recommend awarding a medal.

There were hundreds of buildings erected during this period, the majority of which were of the cheap, mediocre character, although there were about a dozen in which an endeavor of architectural embellishment and proportion had been made. These were visited by the jury in a body and were carefully inspected. All were found lacking in some particular, it being the decided opinion of the members of this jury that it would be very serious to award a medal unless a building was good architecturally, as it is the aim of the Chamber of Commerce in making these awards to stimulate better architecture and better buildings in the various classes, and it was felt that it would defeat these aims were we to make an award to a building which did not come up to a certain architectural standard.

Report of City Plan Committee, 1919.

Three years of endeavor to point out the best building in each of the classes and thereby improve, by force of example, the type of buildings erected in Cleveland in these three classes, has resulted, on the face of the returns of conscientious, competent and impartial juries, in four cases out of nine in finding that no building constructed in these three classes in the city is worthy to point out as a standard. Your city plan committee, therefore, is compelled to the belief that some force other than that of example—especially where there is no example—must be applied if Cleveland is not to be a city of mediocre or worse buildings.

There are not less than five different sets of people interested in every new building constructed within the City of Cleveland—those who will live in the building, those who will live in the neighborhood of the building, those who invest their money in the building, those who have invested their money in the neighboring buildings or real estate, and the general body of citizens who see the building and are affected by it day by day.

All of these interests are entrusted to the foresight and public spirit of the original planner of the building. His primary object is, very often, to safeguard his own immediate financial interests, and too often this is accomplished at the sacrifice of all the other interests concerned.

Public opinion is the surest control in the long run, but it must understand very clearly how its interests are being neglected or damaged before it acts. This subject is too complicated for presentation except by example. Your committee hopes to continue the series of medal awards and so mark the best building, but to improve the average building and to prevent the erection of the worst ones your committee heartily endorses and recommends for the approval of the board of directors the following tentative plan for the control of building construction.

Your city plan committee recommends that it be authorized to bring about co-operation among the lenders of money on building loans in organizing a bureau of architects, engineers, builders and such other technical experts as are necessary, the lenders agreeing that the plans of buildings upon which they make building loans shall be subject to the inspection and approval of the bureau. In outline the plan contemplates:

(1) That this bureau shall grade the building plans presented to it in proportion to their desirability.

(2) That this grading shall be accompanied by recommendations looking to the improvement of the plans, in cases where improvement is desirable.

(3) The financial institutions shall make effective this grading and the acceptance of the advisory recommendations by lending a larger or smaller percentage of the cost of the building in the ratio in which the technical bureau believes it warranted.

In the opinion of your committee this is the most practical method of securing to the borrower on small building operations the services of competent technical advisors. To pay the fee of a trained architect for designing a single $3,000 house is possible only under exceptional circumstances. By means of the helpful co-operation of this bureau such services could be secured, and the small fee would be returned many

times over in economy of cost, or improvement of some feature of the plan, or use of some particular construction or material.

To the lending institutions, the advantage of this plan, or some modification of it, is obvious. The certificate of the bureau that a building is properly constructed, that the plan is adapted to the demand in size, arrangement and price for that particular class of building in that particular locality, that the mechanical equipment is sanitary, safe and durable, should result in more ready sales. The investment, both to the immediate lender, but especially to the ultimate investor, is much better protected.

Both from the civic and the financial viewpoint, this plan, or such modification of it as is found desirable, seems to your city plan committee well worth putting into operation, and with the co-operation of those financial institutions which have expressed an interest in it and of others which it is hoped to interest, success would seem to be a reasonable expectation.

Farm Lighting Plants.

Fire Hazards and Proper Installation.

By William S. Boyd.

(Member N. F. P. A.)

The farmer is one of the last men in the world to realize the importance of good engineering, but he is beginning to realize it today, and he is employing it on the farm. It has brought to the farm and has brought to the attention of industry in general the wisdom of using the right thing in the right place and in the right way.

In a farm lighting plant two factors appeal to the farmer, reliability and cost. If the farmer always considered cost, every farmer would have a Ford, and while a great many farmers do have Fords, many of them have more expensive cars. Reasonable economy will appeal to the farmer just as well as to the business man.

The farmer must have reliability. He is far from any service station, as a rule. It is difficult to bring repair or maintenance men to his premises, and he must keep moving all the time.

Good electrical equipment will require little or no replacement. If reliable fittings and material are used, the installation will be comparatively inexpensive, of which the first cost will practically cover everything until the devices wear out; reliable and suitable equipment has a wonderful life as far as service is concerned. The problem is to make the manufacturer, the installer and the user of the farm lighting plant realize the importance of proper electrical equipment.

Historical.

It is always desirable, in handling a problem, to look back upon history and obtain from the mistakes of others the necessary wisdom to

avoid them. The electrical industry is a young one; the first commercial electric light plants were started within the memory of many readers. The first installations of any moment took place in the textile mills of New England. They were rather carelessly installed. In fact, there was very little known about electricity in those days, and it was necessary to feel one's way along in taking care of installation problems. A great many fires were started in those mills by defective electrical conditions. In fact, the electric generator and the wiring and devices attached to it acquired a very bad reputation for starting fires, and insurance companies for years practically refused to insure plants which were equipped with electric lights. Of course, there were a number of exceptions. The situation became so acute and the losses so excessive that the fire companies employed electrical engineers to devise ways and means of making these plants safe. Wiring rules were compiled, published, distributed and enforced. These rules operated to greatly reduce the number of fires; and as a result of this achievement, together with the educational work of the salesmen of the manufacturers of electrical apparatus, the bad reputation that was acquired by the pioneer electric light plant was gradually modified, but not before it cost the electrical industry millions of dollars. It was a very expensive experiment.

Farm Lighting Plant Has Bad Reputation.

Now, in some way, in some quarters, the farm lighting plant, not so much the plant itself as the wiring attached to it, has acquired a reputation that is not of the best and, in my opinion, not entirely deserved. As far as I have been able to learn, this reputation exists largely in some of the offices of the state fire marshals of the various states, the offices of the various electrical inspectors operating in the cities, towns and villages of the United States, and in the offices of certain insurance companies who make a specialty of writing so-called "farm business." These are generally known as farm mutuals. I haven't the honor to represent them, but I have had some correspondence with them, and I am giving the impression I gained from it. As far as I have been able to learn, it is an impression that has been brought about by the bad appearance of installations due to careless wiring methods. I do not believe there have been many fires, although there have been some, but these insurance companies remember past experience with defective electrical conditions, and the tremendous loss of property which resulted. The farm lighting plant is inheriting a little of the old reputation which careless or ignorant wiring methods placed upon the shoulders of the electrical industry many years ago.

Defective electrical wiring and apparatus is today charged with producing a greater property damage by fire than any other known cause. Electricity, as a cause, leads in the amount of fire loss in nearly half of the states, and it is second or third in most of the others. This will explain to some extent the bad reputation which the farm light plant has acquired. This bad reputation has been augmented by careless installation methods which prevail in some sections of the country. This must be overcome, and I believe it can be overcome very easily by proper installation methods.

Good Engineering Practice Vital to Industry.

Good engineering practice, good engineering methods put into operation today will do far more good than the very large expense to which the farm lighting industry may otherwise be forced in living down this so-called bad reputation four or five years from now.

The electrical industry, as it existed prior to the appearance of the farm lighting plant, was affected adversely by poor materials and devices, as well as poor workmanship. Workmanship was the first phase of the problem that was successfully coped with. The large manufacturers of machinery finally decided to send out specially trained men to work with the mechanics doing the installation work. In the old installations that were in service prior to 1889 or 1890 the work was very carefully done, the splices were wonderfully well made, beautifully soldered, the molding work was that of an expert cabinet maker. The superior workmanship of the electrical installer in the early days prevented a great many fires; in fact, he did a very large portion of the work of saving the industry.

Later the devices were improved. This began about the year 1893 or 1894, and has continued ever since. The last feature of electrical work to be improved was the material. The improvements in the quality of material and devices were brought about in the right way, and ever since there has been a constant noticeable progress.

52-Volt vs. 110-Volt Systems.

When I first entered the electrical business, the 110-volt D. C. machine was by far the most popular constant-potential generator made. It was the first machine generally introduced for supplying current to incandescent lamps; it was the first to be generally known, and was very popular. The alternating current machine, with its 1,100-volt primary and 52-volt or 104-volt secondary, was just coming into use; the manufacturers recommended service at fifty-two volts. There was a strong rivalry between the two systems; the supporters of the 52-volt A. C. system and the supporters of the 110-volt D. C. system were quite antagonistic. The adherents of the 52-volt system said that their system was much safer than the 110-volt system because it operated at less than one-half the potential. But this proved to be untrue, and though the story sold a great many machines, the salesmen were not able to make good with it. It required twice as much current to operate the lamps as did the 110-volt system, and the extra current needed often caused a good deal of trouble. The switch contacts were not always adequate to take care of the current required. They heated up, sometimes burned out; frequently the switch got so hot that people couldn't use it; it melted the buttons and the switch had to be replaced. Then there was such a heavy drop on the circuit that it was difficult to give good service. The early installers endeavored to use wire based on 110-volt experience, and of course, it was too small. They had all sorts of trouble until they realized that the low potential proposition was like a two-edged sword, that, while it made a good talking point, it required a great deal more material to take care of it properly than did the 110-volt installation, and the failure on the part of the machinery men to realize this need of extra copper

often brought about an installation which failed to give good service. The 52-volt system was soon abandoned.

Wiring Details and Fittings.

The farm wiring problems are somewhat like those of the average manufacturing plant: a type of wiring and equipment which would take care of one part of the farmer's premises will not necessarily be suitable in another. For example, when considering the stable, experience in the older portion of the electrical industry will show that ordinary drop cords are not suitable. They serve for a time, but shortly they have to be replaced, as they deteriorate rapidly. The well known brass-shelled socket will not do well there for any length of time. It will give good service for a certain period, but eventually it will disintegrate. The ordinary switch will have the same experience. There is apt to be present more chance for mechanical injury to equipments in the stable than would naturally be expected in the home. The application of whitewash or cold water paint to the interior of the average stable helps disturb and disintegrate the wiring. Reports which we have received indicate that in some quarters, at least, very little attention is paid to good engineering practice in bringing about the right sort of wiring in stables and other similar farm buildings. If, for example, the farmer expects to have lights on the outside of his buildings, there doesn't seem to be any good reason why the same type of wiring and devices that are suitable for lamps on the exterior of buildings connected with the 110-volt installation should be different from those connected with low voltage systems. The fittings are exposed to moisture, bringing about corrosion, and there is more or less mechanical injury brought about by the handling of ladders and so forth in connection with painting the building or making repairs. Then there is considerable lamp breakage to guard against.

The dwelling, perhaps, is the simplest of the problems met with. There is the portable lamp which is often used and which needs attention; and the heater circuit in the case of the 32-volt system is one that must be specially cared for, and introduces a much larger problem than does the heater circuit in connection with the 110-volt system. The same is true of such circuits as are to be connected with motors. The average farmer has a garage. As far as we can see, there is no reason why the 32-volt system should not be governed by the same rules as the 110-volt system in connection with a garage. The lamps and fuses are just as likely to start an explosion as those of the 110-volt system.

Special 32-Volt Fittings Not Desirable.

It has been urged that the farm lighting industry needs a special set of electrical fittings designed for low voltage and heavy current capacity. In my opinion it would be a mistake to place upon the market special heavy current sockets, switches, plugs, etc., which would not be usable on 110-volt systems. This would increase the problem of manufacturer, jobber, supply dealer and inspector by establishing an additional class of fittings to design, manufacture, distribute, install and control. If the present 110-volt fittings do not have adequate current carrying

capacity, the attention of the manufacturers should be called to the matter, and adequate fittings will soon come forth. The expense of manufacturing, distributing and handling a special line of fittings serviceable only to farm light users would be no small objection to the undertaking.

Inspection.

It has been my experience that installations placed in buildings by even the very best of men, the most reliable of men, should be inspected, because it is very often the case that a man, though very reliable, may for some reason be called off the job before he finishes important work in connection with the circuit he is then running. The man who follows him may not be careful to inspect the work, and he may finish that job, or call it finished, and yet leave on the premises vital defects. Even the best workman should be followed by an inspector. There have been presented in a general way a number of methods of bringing about this inspection. Farm plants are often far from railroad lines or trolley lines, and quite a distance from the larger cities having inspection service. This introduces quite a number of problems. In some few states bureau inspectors cover practically all of the state, and they are able, when requested, to take care of practically any farm installation within that state. There is the inspection by the farm mutual inspector, the man who examines into the fire possibilities of the risks that are written by his company. He isn't interested in every farm and, therefore, he might touch only a limited number of the better class of farms. It has been proposed in at least one state that the state fire marshal associate with his office an electrical man who can look after farm installations. It has also been proposed that a state department of electrical inspection be established, with inspectors who would be located in different parts of the state, available for inspection service.

It has been suggested that insurance agents be trained for this sort of work. Such an inspection service would necessarily be inferior to that which would be possible by trained electricians, but the insurance agent can be taught to examine into certain features which have been known to be troublesome, and he can be taught to detect such defects, and show the electrician how they should be remedied.

It has been proposed that the farm lighting industry could in some way coöperate to establish a bureau of electrical inspection which would be effective. This is perhaps the best suggestion, for it could be inaugurated without the delays incident to establishing state bureaus.

Public Service Company Connection Possibility.

Large public utility companies are combining to run high tension transmission lines across the various states in which they operate, tying together plants in widely separated localities. Nobody can tell when one of these transmission lines will pass some farm where there is a farm lighting plant. There should be but one investment for the wiring in connection with the home or with the farm property, and it should be made available for connection with the public service company's lines

should they ever be extended to the farm. Plants that are installed in accordance with good engineering practice will survive a great many years; the ultimate life of an electric plant has not yet been established. Farm plants are doubtless quite durable, except that the storage battery may need occasional replacement. If the farm wiring installation is properly designed and placed, when the electric plant builds a line into the vicinity, one or five or ten years hence, it will then be ready, without charge, to be attached directly to the central station system.

Summary.

The requirements for safe farm lighting plants may be grouped as follows:

1. There should be good engineering in connection with the production of the plant; that is, the engine, the battery, and the generator.
2. The materials should be of the very best grade.
3. Fittings should be of suitable design and manufacture.
4. The workmanship in connection with installation should be superior in every respect.
5. Maintenance of these systems should be given the same attention that is given the systems operating at a higher voltage.
6. There should be adequate inspection.

NOTE:—The 1920 edition of the National Electrical Code contains a section dealing specially with low voltage farm wiring.

An Analysis of Electrical Fire Causes.

By Charles H. Lum.

(Member N. F. P. A.)

Electricity as a cause of fire is credited, for the year 1918, with a total of 15,691 fires, with a loss of $20,780,307 in the United States, according to statistics compiled by the Actuarial Bureau of the National Board of Fire Underwriters. This loss is annually increasing, in spite of the apparently thorough safeguards now thrown about all use of electric current.

The records of the Actuarial Bureau show the electrical fire losses and their relation to the total for the United States as follows (1918 is the last year for which statistics are complete):

Year	*Electrical Fires*	*All Fires*	*Per Cent due to Electricity*
1915	$11,136,930	$164,121,299	6.8%
1916	16,559,433	208,706,362	7.9%
1917	19,885,522	231,628,040	8.6%
1918	20,780,307	283,103,101	7.3%

That these figures are well below the actual destruction from this cause is indicated by the fact that, in coding for tabulation any fire which is ascribed to "unknown cause, but possibly or probably electricity," is

assigned to the class of "unknown causes." This is done even in cases where defective wiring is ascribed, but no further explanation or description is given, for it has been found that "electricity" and "rats and matches" are frequently used by adjusters in designating the cause of a fire which is in reality of unknown cause. Moreover, the statistics compiled by the Actuarial Bureau include only reported fires; it is estimated that the totals should be increased at least twenty-five per cent to cover the large number of fires which are not reported. It is, therefore, more than reasonably safe to state that the figures for electrical losses are conservative.

Attention is called to the very decided increase in the amount of these losses, an increase of $9,643,377 in four years. In number, however, the electrical fires have shown little difference; during 1917, 15,171 were ascribed to this cause, while there were 15,691 in 1918.

The amount of work involved has made it impossible to further subdivide the electrical causes of fire in the annual tabulations. But for one week, beginning January 12th, the reports on electrical fires were segregated. Of the reports received during this week, 540 covered fires caused by electricity. An analysis of these showed that 252, or 47 per cent., were from electric irons, and 82, or 15 per cent., were due to flexible cords. This left 206, or 38 per cent., for all other electrical hazards combined.

The electric pressing iron is undoubtedly one of the most prolific single causes of fire known. When properly used, it is as safe as the old-fashioned smoothing iron, but under the influence of the well-known American carelessness it becomes an exceedingly dangerous device. Various features have been added in the attempt to make it foolproof, but none has thus far proved to be satisfactory.

The misuse of flexible cords, where employed as extensions of circuits or where exposed to severe mechanical injury, is responsible for fifteen per cent of our electrical fires. The ordinary householder finds this to be easily handled and not necessarily unsightly, consequently the temptation to the amateur electrician is very great, and leads quite unconsciously to innumerable hazards. Such violations of proper practices are not found when making inspections of new equipments, but are very common in those which have been used for any length of time. Through ignorance, the user of the equipment generally believes himself to be safe, and when attention is called to the hazard he often shows an inspector an extension which has been in use for five or ten years without having ever blown a fuse. Nevertheless, this practice constitutes an ever-present potential hazard, and the older the installation the more serious the hazard is usually found to be.

This consideration leaves 38 per cent. of the electrical fires in the week under discussion to be accounted for. Seventy-six of the fires noted were in attics, basements or on side walls, chiefly attics and basements, and practically all were traceable to mechanical injury or to inexpert tampering. It is a well-known fact that open wiring is much more subject to unauthorized additions than are either concealed knob and tube or conduit installations. It is, therefore, reasonable to assume that some of

these fires were from cord extensions, but several reports indicated the wires to have been subject to mechanical injury.

Defective switches, fixtures, etc., were responsible for nineteen fires and the crossing of trolley or high tension wires with service wires for eleven. Motors were shown to have caused six fires, one of the latter with a loss of $25,486 resulting from the ignition by a fan motor of some hangings in a store, and one was started by the fan motor in a motion picture booth. Defective installation at outlets or other definitely stated locations caused fifteen fires, and the remainder were due to a great variety of defects or carelessness, the most interesting being the placing of lamps in beds to warm them. In three cases the absence of lamp guards, resulting in the breakage of lamps, was responsible for a blaze; two of these were in manufacturing plants and one was in a dry cleaning establishment where flammable liquids were used.

Electricity probably has more safeguards thrown around it and receives more inspection than any other hazard, but our statistics show it to be still the cause of more fires than spring from any other single hazard.

The figures quoted show beyond a doubt that an almost unbelievably large percentage of electrical fires are due to the careless use or to the absolute misuse of materials and devices, while very few are due to defects in the original installation or in the materials and devices. It would, therefore, seem that education of the public as to the electrical hazards constitutes the only remedy; this is obviously a very long and difficult undertaking.

When we have taught the users and owners of electrical equipments that these must not be added to or changed except by electricians, and that although father's son can install a front door bell which works it does not follow that he can qualify as a first-class electrician, we shall have removed one of the prominent hazards.

An electrical installation deteriorates through wear and tear, but few of us appear to realize the fact. How many inspectors have ever been called upon to inspect an equipment which has not caused any trouble, merely to recommend renewal of worn-out or deteriorated parts? The lighting companies and manufacturers of materials and devices used in electrical work, electrical inspection departments and the Underwriters' Laboratories have coöperated fully in safeguarding electrical hazards, and an installation properly made and kept up presents a minimum of hazard. However, the greatest of all fire causes in the United States—American Carelessness—works through this agency to probably a greater extent than any other, save matches alone.

Although electricity is shown by the statistics to be a leading cause of fire, an analysis of electrical fire causes shows that it is more properly speaking simply the agent of that greatest of all fire causes,—American Carelessness.

Recent Developments in Testing of Fire-Resistive Building Materials.*

By W. A. Hull.
(Bureau of Standards.)

The time has come when more and more of our building is being done with incombustible materials and the effectiveness of various types of construction in respect to their ability to resist fire will depend in large part on the completeness of the engineering information available as to the fire-resistive properties of materials and types of structures. It is the function of the fire-resistance section of the Bureau of Standards to add the results of its investigations to the existing information of this character.

That part of the work of this section which is of most immediate interest to manufacturers of building materials is the fire testing, not only of the materials themselves, but also of full-size building members. From these tests information is gathered which could not be obtained in any other way. The first testing that was undertaken in the Bureau of Standards was that of a number of light metal safes or cabinets for the storage of records and their preservation against fire. A thorough study was made of the leading makes then on the market and a complete report, including drawings of the safes, descriptions of the methods of construction and insulation and of their performance in fire tests was prepared. This report was not published, but was transmitted to the general supply committee of the government for their guidance in purchasing safes. It was also placed in the hands of the manufacturers of the safes tested.

The next undertaking was a series of tests on some of the most important materials used in fire-resistive construction. The results of this investigation have been published in Technologic Paper No. 130 of the Bureau of Standards under the title, "A Comparison of the Heat-Insulating Properties of Some of the Materials Used in Fire-resistive Construction." The method used in this investigation was perhaps somewhat unique. It consisted essentially of the fire-testing of cylindrical specimens of the different kinds of material in a specially designed gas-fired furnace. The cylinders were made 8 inches in diameter and 16 inches long. Small holes running lengthwise through each cylinder at definite depths from the cylindrical surface made it possible to insert thermocouple wires for the determination of temperatures. Temperatures were measured at frequent intervals during the fire test, and from the data thus obtained it was possible to make comparisons of the protection against fire that would be afforded load-bearing structural members by coverings made from materials belonging to the same classes as those tested.

* Extract from address at meeting of National Brick Manufacturers' Association, reported in *The Clay Worker.*

One of the significant indications was the wide difference in the rates at which temperature progress due to heat penetration took place in cylinders from different kinds of burned clay. The tests gave strong evidence of the superior insulating value of porous burned clay over that which is denser. The heat-insulating properties of burned clay with a porosity of from 31 to 37 per cent. were indicated to be about the same, under fire-test conditions, as that of some kinds of concrete.

Comparison as to the heat-insulating properties of different kinds of concrete were favorable to slag concrete and limestone concrete. Limestone concrete showed superiority in point of strength after undergoing the fire test. This was surprising in view of the fact that limestone had been regarded as unsuitable for use as an aggregate in concrete in fire-resistive construction. Fire tests of full-sized reinforced concrete columns have since confirmed the results of the tests of these smaller specimens in regard to the limestone, showing that it is an excellent aggregate for fire-resistive concrete.

Interesting results were obtained from tests of gypsum cylinders. The heat-insulating properties of this material were known to be good, and the records made were consistent with information already existing. The heat-insulating properties of lime mortar were shown to be good. Both lime mortar and gypsum specimens were very weak after fire test.

The largest and most important piece of work in which this section of the Bureau of Standards has been engaged is the fire-testing of a large number of full-size building columns that has been done jointly by Underwriters' Laboratories, the Associated Factory Mutual Fire Insurance Companies and the Bureau of Standards. This investigation, which has been carried on at Underwriters' Laboratories at Chicago by representatives of the three participants, has covered a period of approximately five years, and is an exceedingly comprehensive piece of work. The most important types of steel building columns, a number of types of concrete columns and even of wood columns have been subjected, under the most carefully controlled conditions, to the standard fire test, governed by conformance to the standard time-temperature curve that has been adopted in this country to be followed in such tests.[1] All observations that could be of value in the study of the behavior of columns, under load, when subjected to fire, have been taken. The equipment for this work has of necessity been elaborate and expensive. The design, installation and perfection of the deformeter alone, the apparatus for measuring the deformations which took place in a measured portion of each column, while in the furnace under fire, constituted an important investigation in itself, and this represents but a small part of the physical equipment required for such a piece of work.

The investigation proper began with the testing of steel and cast-iron columns with no protection whatever. These tests were extremely short in all cases, as would be expected. They afforded valuable engineering information and will serve as an object lesson on the necessity of protecting steel columns and other members in buildings against heat. Following this part of the work, steel columns of several types, protected

[1]Proc., A. S. T. M., 1917, Report of Committee on Fireproofing, p. 296.

by different types of coverings that are in use for the protection of columns in buildings of fire-resistive construction, were tested. The protective coverings included several forms of concrete protection made from concretes containing different types of aggregates; a number of forms of protection produced by the use of plaster on metal lath; the important types of gypsum block protection, the important types of clay hollow-tile protection and protective coverings built of brick. Separate tests were made of the properties of the materials used in the building of the columns, protected and unprotected, and the work involved in these tests alone was no small matter.

This investigation has been completed and a thorough and comprehensive report has been prepared which is now in process of publication. It would be inexpedient to make fragmentary statements regarding these results before the whole structure of evidence, interpretations and conclusions is available for study. It is sufficient to say that these results will show the need that has existed for just such an investigation which would not, in all probability, have been carried out at all except by laboratories representing and supported by national bodies.

In order that as large a part of the field as possible should be covered at the same time, the Bureau of Standards has carried out, independently, at its Pittsburgh laboratories, an extensive investigation of the fire-resistive properties of different types of reinforced concrete columns. The first progress report of this work was published in 1918, and may be found in the *Proceedings* of the American Concrete Institute for that year. A second progress report has been published in the *Proceedings* of the Institute for 1919, and a summarized report of the whole investigation has been presented for publication in the *Proceedings* for 1920. A comprehensive account of this work with a full presentation of the data obtained will be published as a Technologic Paper of the Bureau of Standards.

It is unfortunate that it is the results of the tests of concrete columns instead of tests of steel columns that are available for presentation in this paper. The record made by different types of hollow tile and brick protection would be of special interest, especially when compared with the performance of other kinds of protective materials; however, the importance of definite engineering data which will aid in effecting economies in concrete construction, especially in the skeleton construction type, without sacrificing safety to cost, is of such evident importance that such data must also be of interest.

The Pittsburgh laboratory of the Bureau of Standards has a gas-fired furnace for the testing of full-size reinforced-concrete columns. It is provided with a suitably supported oil-driven jack operated by a hand test pump. The capacity of the jack is 500 tons. The rated capacity of the steel structure holding the jack is 300 tons. Most of the columns tested have been 18 inches in diameter; some have been larger and a few smaller. All columns were 8 feet 9 inches long. Columns were made in the laboratory. Thermocouple wires were placed in the forms before casting concrete and were so held by suitable devices as to insure that they would be so located, in the completed columns, that temperatures could be obtained, during the progress of the fire test, from definite points in the steel and in the interior concrete. The wires for measuring the tempera-

ture of the steel reinforcing rods were attached to the rods by inserting their ends in small holes drilled in the rods and peening them in.

When the column was in place, ready for test, pressure was applied by means of the jack until the gage indicated that the load on the column was equal to the rated safe working load for that column; then the fire test was started. In the course of the fire test, as the column expanded, with a tendency to increase the load, a little oil was let out of the jack by cracking a valve at the test pump so as to prevent the load from increasing. In case the load indicated by the gage showed a decrease, due to leakage of oil or to compression of the column, it was brought up to the original point by pumping. Temperatures were measured, in the furnace and in the interior of the column, by means of iron-constantan thermocouples and a Leeds and Northup potentiometer indicator. The firing was governed so as to conform, as nearly as possible, to the standard time-temperature curve for fire tests, previously referred to. A fire test in which the rate of heating corresponds to the standard curve for fire tests is supposed to represent the conditions of an extremely severe fire. The rate of heating is extremely rapid, and a test of this sort may be expected to develop spalling in most test specimens which have a tendency to spall.

In the fire tests of concrete columns spalling was shown by some kinds of concrete and no spalling whatever by other kinds. The tendency to spall was found to depend on the kind of coarse aggregate used in the concrete. Concrete made from gravel with a high content of either quartz or granite had a tendency to spall; concrete made from a gravel containing about 90 per cent. of limestone pebbles and, of course, but little quartz or granite did not spall at all. Concrete made from crushed limestone, blast-furnace slag or trap rock did not spall at all in any instance. Extremely good records were made by all types of columns made from concrete in the non-spalling class.

It was the practice, in making these tests, to increase the load on the column, while it was hot, at the end of a fire test lasting for four hours, to test the strength of the column when in its weakest condition. There were a few columns made from gravels high in quartz or in granite content which failed under their working load before the fire test had gone the four hours; compared with concrete columns made from non-spalling types of concrete such records are obviously poor; judgment should be withheld, however, as to how these records compare with those made by steel columns with various types of protection until the results of the tests of protected steel columns are published. None of the columns made from the non-spalling aggregate lost much more than fifty per cent of their strength in the fire test; many of them lost less than fifty per cent. The fact should be emphasized that this is based on a comparison between columns tested hot, at the end of four hours of fire test, and similar columns tested cold, without having been subjected to fire test.

Of all the aggregates from which columns were made, the crushed limestone and the gravel containing a large percentage of limestone pebbles made the best records. This is contrary to the former general belief that limestone aggregate was unsuitable for concrete for fire-resistive con-

struction, but the results are so consistent as to remove all reasonable doubt that limestone constitutes an excellent aggregate for such use.

It has been a matter of common observation that concrete, in common with a number of other building materials, sometimes spalls when exposed to fire. As long ago as 1905, attention was called by Professor Ira H. Woolson, then of Columbia University, to extremely poor and even alarming results which he had obtained in the course of a study of the fire-resistive properties of concrete, from specimens in which the aggregate was a pure quartz gravel that was being used as an aggregate for concrete in the vicinity of New York City.[2] He attributed the extremely poor results shown by this particular kind of concrete to peculiarities in the expansion of quartz. Several years later other peculiar features in the expansion behavior of quartz, especially at high temperatures, were discovered,[3] and it was also learned that the behavior of granites was very similar in this respect to that of quartz. The facts that are now known as to the physical properties of these two minerals seem to account for the spalling of concrete that sometimes occurs. It may now be said, not that any kind of concrete is likely to spall under certain conditions, but that certain kinds of concrete are likely to spall under certain conditions.

Having found that columns made from certain types of gravels consistently gave poorer results than columns made from other aggregates, several methods for economically building better fire-resistive columns with concrete made from these aggregates were tried. These methods included, among other things, the plastering of such columns, the use of plaster to take the place of a large part of the concrete that is provided, over the steel, to protect it from heat, and the use of light reinforcement such as a light grade of expanded metal in the protective concrete to prevent its being displaced in case of spalling. A statement of the results obtained with these methods may be found in the summarized report presented to the American Concrete Institute. It is sufficient for the purpose of this paper to say that it has been demonstrated to be practical to produce without excessive cost reinforced concrete columns made from concrete in which the high-quartz and high-granite gravels are used, which can be depended on to resist extremely severe fires.

It may be said that the results of this investigation have removed the most important uncertainties in regard to the fire-resistive properties of reinforced concrete in skeleton structures and particularly in columns.

It has been shown that satisfactory reliability in respect to the behavior of concrete columns under fire can be obtained in many localities by the selection of one of the more favorable aggregates, and that in localities in which only aggregates high in quartz or granite are to be had at reasonable cost, such an aggregate can be used and the column made safe against fire if one of a number of methods, involving comparatively little additional expense, is employed.

The Bureau of Standards now has under way an investigation of the

(2) "Investigation of the Thermal Conductivity of Concrete and the Effect of Heat Upon Its Strength and Elastic Properties," by Prof. Ira H. Woolson, A. S. T. M., 5, 1905, and 6, 1906.

(3) "The Determination of Mineral and Rock Densities at High Temperatures," by Day, Sosman and Hostetter. Am. Jour. Sci., 37, p. 1, 1914.

strength of steel at high temperatures and another on the fire-resistive properties of wall plaster and of partition constructions in which different kinds of plaster are to be compared. Special equipment for the fire-testing of large sections of partitions and walls has been provided. It was necessary that the furnace should be large enough to accommodate a test sample or partition or wall which would develop the same tendencies, under fire, as a similar partition or wall would develop, under fire, in a building. The furnace that has been built for this purpose by the Bureau of Standards will take a test specimen 12 feet high and 16 feet long. Provision has been made for transferring test specimens to and from the furnace by means of a crane. An overhead track, with I-beam travelers, permits the partition or wall specimen to be moved to a suitable position for the application of a hose stream after exposure to fire. Heavy steel frames, made from twenty-inch I-beams, have been built to provide suitable restriction for specimens made from such materials as brick, hollow tile and concrete, in order that the effect of expansion in causing buckling and spalling and possibly even the collapse of the specimen may be developed. This equipment will be especially serviceable in securing information bearing on the question of the suitability of different thicknesses of different kinds of brick, hollow tile and concrete for important partitions and for fire walls. It may appear, at first thought, that we know all we need to know about the fire resistance of the old reliable brick wall; the fact remains that there are some important questions yet to be answered about what a brick wall of a given thickness will do under fire in certain places. In the case of hollow tile, the need for information is comparatively urgent. The record of hollow tile in actual fires has been neither consistently good nor consistently bad. As a result, the opinion of competent, disinterested authorities on fire-resistive construction appears to be generally unfavorable to the use of hollow tile in important fire walls and fire partitions. Hollow tile is made in a variety of designs from clays and shales differing widely in physical properties. Fire tests may take the mystery out of the fire resistance of hollow tile, as they have done in the case of concrete. It would not be surprising if a comprehensive investigation were to bring out the fact that the reputation of all hollow tile has been affected by the behavior of the tile made from some one class of raw material, and perhaps also that certain details of design may have a bearing on the behavior of the tile under fire. Considerable information bearing on the fire resistance of brick, and particularly of hollow tile, will be supplied by the report of the column tests, previously referred to, that have been made at Chicago, and the Bureau of Standards hopes to be able to take up further investigations dealing with the fire resistance of brick and of hollow tile within the near future.

Log Piles: Their Hazards and Protection.

Growth of Fungus and Quality of Pulp.

By F. J. Hoxie.
(Member N. F. P. A.)

Log pile fires occur when the outside of the pile is dry. Most of them have taken place in summer. In cold climates there have been a few large winter fires. The dry atmosphere and snow keep exposed vertical piles in these climates dry in winter. Most of the large losses have been in August.

Dry punk wood is doubtless the chief source of fires in log piles. This light rotted wood when thoroughly dry can be ignited by the smallest spark and will burn with the utmost persistency.

Dry pulpwood can be most practically obtained by piling in low, well-separated piles which can be effectively protected against fire by hose streams. Where wet wood can be used the entire pile can be kept wet and thereby greater uniformity secured, fires prevented and rotting reduced. That wood rots "between wind and water" is a matter of common knowledge, illustrated by the fence post, which rots first at the surface of the ground, where the moisture is most favorable for fungus growth. In order to make practical use of this peculiarity, it will be necessary to determine definitely the moisture limits of the three or four varieties of common fungi which destroy pulpwood as well as roof planks and structural timber.

First Principles of Fire Protection.

There are three grand divisions in the efficient control of fires. Prevention is the first and most important, although the least spectacular; methods of extinguishing are second. These have been given most attention by fire protection engineers because of their conspicuous practicability; the separation of values into parcels of amounts reasonable to risk a total loss even when such a loss is improbable with the means at hand is the third, and is governed to a considerable extent by the prevention and protection available.

When factories were insured with only hose stream protection, prevention was by far the most important factor in fire engineering. Fire extinguishing was more a matter of chance than an exact science. When automatic sprinklers were introduced this chance was greatly decreased by making it more certain to extinguish a fire in its early stages and preventing small fires from becoming large ones. The automatic feature also considerably compensated for defects in fire prevention methods. The reliability of the automatic protection immediately gave it paramount importance. It reduced the uncertainty due to the personal element ever present in fire protection, depending on carefulness and good judgment.

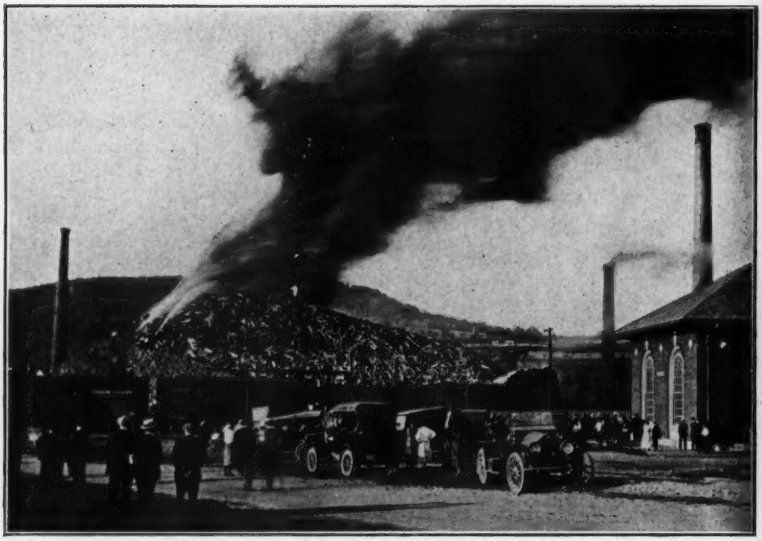


Fig. 1. Fire in pile of pulp wood, started at 7 p. m., August 8, 1919. Cause, locomotive spark. (See Fig 2.)

The success of the automatic sprinkler is the result of its being able to quickly and automatically extinguish a small fire with a comparatively small amount of water. There are but few mills at the present time which have a sufficient water supply to successfully extinguish the entire structure should it all become ignited at the same time.

Velocity of Combustion Determines the Necessary Water Supply.

The velocity of combustion is the factor which determines the water supply necessary to extinguish a fire. A gallon of water can absorb about 9,000 British thermal units, and therefore if heat is being generated at the point where this gallon of water is applied at a rate much greater than 9,000 British thermal units during the time the water is applied, there will be little hope of extinguishing the fire, unless the water can be so applied at the seat of combustion as to reduce the temperature below that at which wood can rapidly combine with oxygen.

The combustion of wood takes place in two stages. The first is destructive distillation such as takes place in a charcoal kiln; the wood is separated by heat into combustible gases and charcoal. The gases burn in the air above the wood and form the luminous flame characteristic of fire. The charcoal burns by combining with oxygen in the original location of the wood, forming an intensely hot and luminous bed of coals. The heat from both burning gases and charcoal distills wood and increases both the temperature and rate of combustion, the increasing velocity of

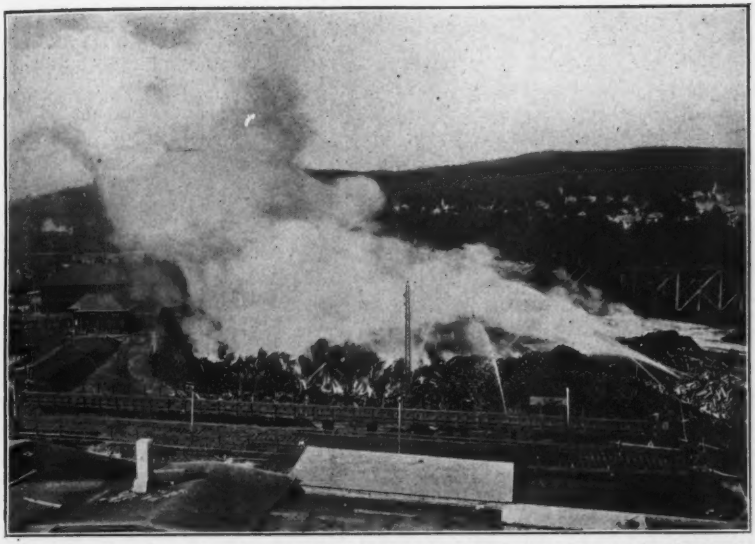


Fig. 2. Same fire at 8 a. m. the next morning. Note central crater. Entire pile, containing 7,800 cords, was practically destroyed.

combustion being only limited by the rate at which air can be brought into contact with the burning wood. In the same way the temperature of a house in winter is regulated by limiting the air supplied to the burning fuel in the furnace by means of the drafts or dampers.

The velocity of combustion of a log pile will at first rapidly increase with the temperature, the temperature accelerating the rate of combustion and increasing the air supply by the increasing upward velocity of the column of hot gases, finally coming into equilibrium at a point at which air cannot be supplied or products of combustion removed any faster.

There are two possible means of reducing the rate of combustion. First by reducing the temperature; second by shutting off the draft. The first is that commonly used in fire fighting, and consists in putting water on the hot coals, thereby reducing the temperature below that at which destructive distillation can take place. In order to accomplish this end with the smallest possible amount of water, the water must be applied to the hot coals at the base of the fire, not to the flames, which are the burning gases, as is frequently done.

It is a matter of considerable difficulty to get water to the seat of combustion against the strong upward force of the column of hot gases. It is impracticable to apply it from the bottom or sides in the direction of the incoming cold air due to the wood on the outside of the pile, which acts like a grate admitting air to the burning wood on the interior through the spaces between the logs. Therefore the fire, once under way, can only be fought with reasonable chance of success by applying large, solid

hose streams from above with sufficient force to overcome the upward force of the rapidly ascending column of gases. If the water is thrown up onto the pile from the ground, it may come to rest in the air directly in the column of ascending gases, and therefore it can be carried aside by horizontal air currents and will not reach the base of the fire where it could exert its greatest extinguishing power.

If more pressure is applied to the hose streams it will cause them to spray and offer greater surface to the buoying action of the ascending gases. The rate of combustion would be expected to increase very rapidly at first and become nearly constant when the air supply has come to equilibrium in the same manner that the fire under a boiler or in a stove burns for hours at a practically uniform rate when the drafts are regulated. Finally when the fuel supply is nearly exhausted the rate of combustion rapidly decreases. Therefore we should expect a large conical log pile to burn at a practically uniform rate for a considerable period, and the combustion would take place within a comparatively small area due to the concentration of the fuel; therefore it would be necessary during this period to apply water in sufficient quantity to absorb the heat faster than it is generated in order to extinguish the fire.

An idea of the amount of water which would be required can be obtained from the following table, in which the velocity of combustion of several of the more important log pile fires has been calculated from the fire reports, and opposite this has been placed the amount of water available as near as could be estimated, taking 2,500 pounds of dry wood to the cord as an average figure and the heat equivalent of dry wood as 7,000 British thermal units to the pound.

Velocity of Combustion of Log Piles and Water Supply Available.

Date	Cause	Hose Streams	Hours time	Lbs. of Wood Burned per minute		Gals. of Water per minute
6/13/00	Exposure	7	20	*4000	e.	2000
5/ 5/03	Conveyor	5	6	80	e.	1500
5/13/08	Unknown	9	13	1200	e.	2000
5/14/10	Locomotive	7	8	2100	e.	2000
6/ 4/18	Unknown	15	27	14000	c.	3500
8/ 4/18	Conveyor	14	36	28000	c.	3500
8/ 8/19	Locomotive	22	13	25000	c.	3000
8/19/16	Forest Fire	—	60	17000	c.	——

(e.) Extinguished.
(c.) Consumed.
(*) Low flat piles.

Each pound of wood will require approximately a gallon of water to absorb all of the heat generated. That this is supported by experience is shown by the fact that, when the rate of burning is much in excess of this, the fire is not extinguished until practically all of the wood is consumed. Another factor worth noting is the rather constant velocity of about 25,000 pounds of wood per minute at which the larger conical wood piles have burned, showing that in the larger fires the period of

Fig. 3. Collection of grated punk wood and bark deposited on platform by conveyor above.

constant velocity due to draft equilibrium occupies nearly the entire time of the fire.

From the above figures it is apparent that if the rate of combustion at the fire of August 11, 1919, had been uniform throughout over 25,000 gallons of water a minute would have been necessary to have absorbed the heat. It is apparent that an average large water supply of 2,000 to 3,000 gallons per minute can only be expected to control a fire in a large conical pile if applied in the very early stages of the fire.

The amount of water contained in the wood is important in slowing down the rate of combustion at the start and making it possible to get hose streams on the fire before it has attained too great velocity. This may be the reason that while there have been more fires in the early part of the season they have generally been more successfully extinguished than the fires which have occurred in August, when the wood on the surface of the piles is more thoroughly dried, causing the fire in the early stages to spread more rapidly. The August losses have been about five times as much as the combined losses of all other months.

To supply the amount of water required in the later stages of the fire, according to the above calculations, seems to be beyond the range of practicability. Where the same method of computation is applied to large paper mill or cotton mill buildings, it will be found that the hose streams available are about equally insufficient, although in this case the fuel is spread over a much greater area, but the results have generally been disastrous when the fire has passed the first lines of defense and gotten well under way.

A similar method of computation was used as a basis of determining the spacing of sprinkler heads necessary to control fires in celluloid, a substance which burns ten to fifteen times as fast as wood, and therefore must have water applied ten or fifteen times as fast in order to control it. The calculated number of heads were installed in a small vault in which large quantities of celluloid were burned experimentally, and the results showed that the method of calculation was remarkably reliable.

Fig. 4. Permanent conveying systems may readily be utilized in connection with fire prevention and protection.

Open Sprinklers in Continuous Operation Are More Efficient Than Automatic Sprinklers.

The common cause of failure of automatic sprinklers is some unforeseen obstruction, such as a shut valve, an obstruction in the pipe, or a defect in the controlling link; therefore if it were practicable to use open sprinklers operating continuously instead of automatic sprinklers, the greater part, if not all, of the failures would be eliminated, as with the sprinklers in continuous operation any defect would be immediately discovered; moreover, it would not be necessary to extinguish fires, as the combustible material would be kept too wet for a fire to start, and the sprinkler, instead of being an extinguisher, would become a device for prevention.

This form of protection, while impracticable for factories, is entirely practicable for many of the larger log piles. A perforated pipe of moderate size or a series of large sprinkler heads can be extended along the conveyor over the top of the pile and supplied by a pump of reasonable capacity, kept in operation throughout the summer months, the object being to maintain moisture on the surface of the wood at about the same amount that is maintained by nature through the remainder of the year, which seems to be entirely successful in preventing fires. Open sprinklers in continuous operation throughout the summer months should afford protection equal or superior to that of the automatic sprinkler now in satisfactory service inside the mills.

Punk Wood Important Cause of Fire in Pulp Wood.

The reason that a small amount of water can give successful results in fire prevention in log piles is doubtless the part played in ignition by partly rotted or what is commonly called "punk" wood. This material, which is highly combustible when thoroughly dry, takes up water readily from rain or dew, but when the weather is very dry it loses its moisture and can not only be easily ignited by the smallest spark, but the combustion, once started, persists with the utmost tenacity, a fact familiar in

Fig. 5. Punk wood in center of pile.

fence posts when they have become ignited by grass fires. Most of this rotted wood is doubtless present in the logs when they are put in the pile, as rotten hearted logs brought from the forest. Some of this punk wood is grated into small fragments by the conveyor and distributed through the pile.

Fungus plants causing rot can grow in partly dry wood in the pile, causing it to rot in time. Wood kept thoroughly wet will resist this fungus growth, and wood kept dry is immune to rot. That which is kept in an intermediate condition rots rapidly, therefore continuous sprinkling will serve a further useful purpose in retarding fungus growth which is most active in summer, as the low temperature of winter prevents it.

The Process of Combustion and Updraft in Conical Log Piles.

In several of the fire reports mention is made of the fact that the fire started at the top of the pile and apparently burned directly down to the bottom through the middle of the pile rather than over the outside, as would be expected. In the report of the fire of May 19, 1908, a drawing is given showing a conical opening in the middle of the pile which, it is stated, later fell in. A similar phenomenon was observed at the fire of June 4, 1918. Figure 6 shows this condition diagramatically.

The unbarked logs give abundant air spaces for the draft and serve as a grate, with the result that the fire burns from the centre of the pile towards the surface rather than from the surface towards the center. Apparently bark on the logs has a somewhat retarding influence on fires in the early stages, as it tends to shut off the draft by filling these spaces. After the fire is well under way this is probably of less importance, as the updraft caused by the heat will be sufficient to cause a strong suction at the base of the fire. At the fire of June 4, 1918, the logs had the bark on; the exceptionally strong wind was doubtless the important factor in the failure of the hose streams in the early stages of the fire. It will be noted from the velocity table that this was the slowest large fire recorded, doubtless due chiefly to the shutting off of the draft by the bark.

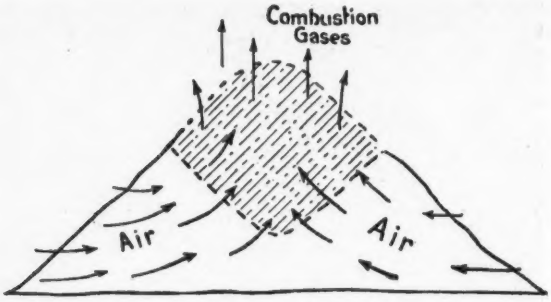


Fig. 6. Diagram of burning log pile.

A further cause of the failure of hose stream protection under these conditions is that it is difficult or impossible to get water to the seat of the fire owing to the fact that there is an enormous updraft in this crater, and on the outside of the piles the logs prevent the water from being thrown onto the fire from the back. This updraft has been stated in several conflagrations to be sufficient to carry burning 2-inch planks to considerable heights in the air. With such a powerful updraft it would not be expected that a small or large hose stream, unless applied downward with force, would be able to get anywhere near the seat of combustion, but instead, such part of it as is not evaporated would be carried by the updraft directly away from the fire. In most of the cases where heavy hose streams have proved effective in extinguishing the log pile fires they have only been brought into service towards the latter part of the combustion, when the walls of the crater had burned down to a considerable extent (see Fig. 2) and the combustion had been distributed over a wide area, considerably reducing the updraft. A very large solid stream of water forced directly down into this crater will be about the only means of successfully combating such fires. How large the stream must be or how to get it to such a height as to force it directly into the crater is a problem of considerable difficulty, especially with conical log piles 100 feet or more high. A good supply of water quickly available on the conveyor or other structure over the center of the pile seems to be the only way that this could be brought into service before the fire attained uncontrollable dimensions.

Bearing of Moisture on the Manufacture of Pulp.

The effect of the amount of water contained by the wood on the process of pulp manufacture has been discussed with several of the most progressive and best informed pulp makers. All agree that for groundwood pulp the most thorough wetting is an advantage; all agree that uniformity in the moisture for the chips for chemical pulp is highly desirable. It is stated that a sulphite liquor can be made of suitable strength for any practicable amount of moisture that the chips can carry, but the same liquor will not give equally satisfactory results in a mixture

of wet and dry chips. In the large log piles in dry weather in the summer time the top of the pile exposed to the hot sun and wind is nearly bone dry, while the interior of the pile protected from these drying influences will doubtless contain nearly 50 per cent of moisture. By the method of conveying the logs from pile to the mill the dry logs from the top of the pile are indiscriminately mixed with the wet ones from the interior, with the result that in dry weather the widest possible variations in moisture occur. If the top of the pile was continuously sprinkled in such dry weather the result would be that the moisture throughout would be kept much more nearly uniform. It would not be possible to get much more than 50 per cent of water into the logs at the bottom of the pile, and those at the top might be kept up to 40 per cent, which would improve their uniformity without greatly affecting the absolute moisture in the chips. Moreover, in the large news mills where the largest wood piles are maintained, at least half of these piles are used for groundwood. Some of the mills now test the chips daily for moisture in order to determine the most desirable strength of the liquor.

Wood from the large piles now averages from 45 per cent to 55 per cent moisture. Wood from moderately low flat piles with only a small amount of spaces between the piles contains from 30 to 40 per cent, and this figure can doubtless be reduced from 20 to 30 per cent by making the piles lower and more widely separated. Dry wood obtained by this method of piling is preferred by makers of soda and the better grades of sulphite pulp. Experience at the fire of June 13, 1900, indicates that the fire hazard of low flat wood piles well separated can be satisfactorily taken care of by a reasonable amount of hose streams and hydrants well distributed through the wood-yard. Moreover, this thorough separation not only makes hose stream protection efficient, but is necessary to obtain the lower moisture content that prevents the growth of fungus in the piles, which is not only a saving of wood, but an improvement in the quality of the pulp produced.

At some of the mills where the best pulp is made, the rotten wood is now carefully separated from that used for pulp and sold for firewood or other purposes. If these mills will go a step further in this respect and separate out the rotted logs as they are received from the river or cars, they will not only remove a source of infection of the piles, but this punk wood which is the chief hazard of the log piles will be eliminated and a more uniform pulp and better yield secured.

Piling of Pulpwood for Either Storage or Drying.

Pulpwood piles can be divided into two classes. The first is wood which is kept to insure a constant supply for the mill and to counteract irregularity in shipments, storage over winter, etc. The keeping of this wood is a storage proposition, and it is probable that if it can be kept from rotting it will frequently be found economical to store part of it for a considerable length of time, using the wood coming in from day to day at the wood room, and only taking from the storage when the shipments are not sufficient for daily use. In this case it will be necessary to study carefully the moisture in the stored wood in order to know when it is too wet or too dry for the growth of wood-destroying fungi.

At some of the mills, particularly soda mills and a few of the sulphite mills making a high-grade bleached pulp, dry wood is stated to be highly desirable. In very few of the mills is there any determined attempt to secure this dry wood by piling or chip drying. It is possible that as the price of wood continues to advance, and the demand for better qualities of pulp increases, dry wood will be sufficiently desirable to make it worth while to adopt piling methods which will secure it. In this case it will be necessary to pile the wood in small separate piles for a certain length of time, the piles being so exposed to the drying winds as to remove the moisture in the shortest possible time. Apparently it is possible in a few months, under favorable conditions, to reduce the moisture to 20 per cent in well-exposed barked piles.

If wood is left in ranked piles for several years, the season cracks opening on the top logs absorb moisture and cause abundant growth of fungi on the top of the pile, such piles generally being found rotted at the top and bottom and sound in the middle, except where some of the logs have projected and thereby taken up an abnormal amount of water.

Water a Cheap and Efficient Means of Preventing Rot.

Sound wood from prehistoric times has been found in the lakes of Switzerland. Water-logged logs from the bottoms of river and swamps are sawed into lumber after having been submerged for many years. Dry lumber in the roofs of churches and in furniture is sound after hundreds of years. Fungus causing rot grows in partly dry wood. Fence posts rot first at the surface of the ground, remaining sound much longer under wet ground and in the dry air above the ground. Observations in the rotting of the weaving mill and paper mill roofs indicate that rotting takes place most rapidly in wood which is at equilibrium with water saturated air. Such wood contains about 30 per cent of moisture.

Exact knowledge is not available as to the upper and lower moisture limits of the common wood-destroying fungi. There are doubtless slight differences in the moisture and temperature requirements of the different varieties of fungus are indicated by the position at which they are found in log piles and on roofs. No fungus can actively grow at freezing temperature. This fact is doubtless useful in keeping logs in the large piles in cold climates where the heat insulating action of the wood keeps the interior of the pile not far from freezing most of the year.

The fact that wood which has been in the water for some time appears to acquire an increasing power of resistance to fungus might be made use of where it is necessary to float logs for some distance in reducing the loss from rotting, the wood which has been a long time in the water being selected out and kept for the storage pile, that which is received by car being put into the wood room at once.

When wood is to be kept for some time in ranked piles, it would doubtless be worth while to split the top logs in halves, placing two layers of the heart or flat side up, giving the piles sufficient pitch so that the flat logs would serve as shingles shedding rain water from the top of the pile. There would be little tendency to form season cracks on the heart

Fig. 7. Lenzites Sepiaria on end of spruce log, kept at a favorable moisture content by nearness to the earth.

side of the split long, thereby reducing the absorption of water and the resulting rotting wood.

Fungi That Affect Pulpwood.

Only a few varieties of fungus are concerned in the destruction of pulpwood. This is due partly to the fact that only a few varieties of wood are used for pulp. The moisture and temperature at which the wood is kept doubtless also is a factor.

*Lenzites Sepiaria** is the most destructive of spruce, hemlock or pine. It grows at the top of the pile where either season cracks or bark causes the wood to take up sufficient moisture to meet its requirements. Frequently fruiting plants will be found growing at season cracks on the top of a log, while the bottom of the same log is too dry to support this growth. When located near the earth, the entire log contains sufficient moisture to support this plant. (See Fig. 7.)

Fomes Roseus has a rose pink fruiting plant and is frequently found on spruce, hemlock and pine. It apparently requires a lower temperature and more moisture than the lenzites, as it is generally found near the earth or in the interior of log piles. Fig. 8 shows it on the ends of a ranked pile of spruce which had another pile close against it here. This plant did not extend to the top of the pile, but where there are three or more ranked piles close together it is almost always to be found on the ends of the centre pile if it remains undisturbed for two years or more.

Fomes Hirsutus is the most common destroyer of poplar and some other varieties of soda pulpwood. It is apparently able to get along with a moderate water supply at the top of the piles.

Polyperous Pargamenus, a smaller bracket fungus, violet towards the edge of the under side of the fruiting plant, is frequently found on birch and less frequently on other kinds of pulpwood. It is much less common than those previously mentioned.

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*Timber rot caused by Lenzites Sepiaria, by Perley Spaulding, U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 114, Page 28.

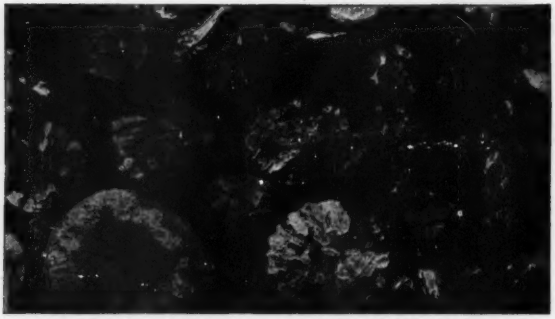

Fig. 8. Fomes Roseus on ends of logs at center of pile.

Many other varieties of fungus are sometimes found on pulpwood, but they are not frequent enough to be important factors in the destruction. A careful study of the habits and requirements of the above mentioned varieties should be valuable suggestions as to the most practicable means of combating them. Observations thus far indicate that controlling the moisture is the most practical method of attack.

Caratostamella Pilifera is a very common sap stain fungus which gives a slate blue color to the sapwood of the pines and many of the pulpwoods. It is generally characteristic of sapwood, but does not cause rapid weakening of the fibre like wood-rotting fungi. The filaments in the wood cells are large and dark colored, and may cause specks in the pulp.

Mr. W. A. McCubbin* mentions a case in which sap stained wood gave discolored pulp. He states that the wood showed discoloration, suggesting rot which is not commonly caused by the sap stain fungus, but sapwood is rapidly attacked by all sorts of fungi to which the variety of wood is subject, and generally several varieties of fungi may be found in the same sapwood.

I am inclined to believe that a cause of specks in pulp may be water-logged sapwood. The sapwood takes up water more rapidly than the heart wood, therefore pulpwood which had been acted upon by water for a short time would have the sapwood saturated and the heart wood comparatively dry, with the result that the sapwood chips would locally dilute the digesting liquor and remain uncooked when the heart wood was thoroughly cooked. In this case it would be expected that this uncooked sapwood would be to some extent taken out by the screens, and these screenings would show the characteristic sap stain fungus, as Mr. McCubbin states was noticed in the case which he investigated. On the other hand, if pulpwood is subject to drying influences the sapwood would be expected to give up its water more quickly than the heart wood, and would therefore be cooked more rapidly. Any method of handling pulpwood which will keep the heart and sapwoods at the same moisture content should correct this trouble.

*Pulp and Paper Magazine, May 15, 1919, page 461.

Fig. 9. Rotten hearted log near railroad. In dry weather such logs are ignited by the smallest spark.

Special Winter Hazards of Log Piles in Cold Countries.

A notable exception to the general rule of log pile fires in summer was a fire in a log pile in a cold climate. This occurred in February and consumed 4,000 cords of wood in three days, which gave a velocity of combustion of 2,500 pounds per minute. Fourteen hose streams throwing about 3,500 gallons of water per minute were unable to extinguish the fire, probably due to the snow and ice, which served as a roof and threw off the water.

At the point at which the pile was ignited it was retained by a high vertical pile which, due to its perpendicular surface, was not covered with snow; therefore it exposed a large surface of wood to the drying action of the wind. The fire was probably started from live coals from a stove in a watchman's house at a surge tank above this pile. The snow and ice prevented the penetration of the water from hose streams into the pile, and doubtless due to the screening action which kept out the air, the most of the wood was transformed into charcoal. This experience suggests that it would be advisable to avoid high vertical retaining piles in cold countries.

Doubtless such vertical piles in cold countries are dryer in winter than in summer, as there is practically no rain due to the low temperature. The snow which covers the top of the pile forms a roof over it, and rather increases the dryness than otherwise.

If such piles could be given sufficient slant to hold snow and ice, this will not only protect the wood from sparks, but will shut off the draft by filling the spaces between the logs. The slow velocity of this fire was doubtless due to the scant air supply caused by the partial covering of snow.

Most of the larger sulphite mills at the present time are using wood containing 40 per cent. or more of moisture, and but few of the mills have wood which contains less than 30 per cent. moisture. From 30 per cent. to 40 per cent. of moisture appears to be the most favorable range for the growth of fungus.

Pulpwood Stackers and Conveyors Can Serve in Fire Protection.

The stacking and conveying apparatus in use at the pulp mills can doubtless be made useful at slight cost in connection with fire protection. In many cases where very large piles of logs are kept, the elaborate conveying system in use will facilitate both the continued wetting of the piles in dry weather as well as quickly getting at a fire on the top of such a pile; whereas rough-and-tumble stacked piles are difficult and dangerous to climb with hose streams, and such a process must necessarily be slow.

It is generally appreciated among the mills that in the next few years careful study must be put into the handling and storage of wood. The high price of wood as well as the high price of labor make it necessary to avoid loss by rotting and the elimination of hand labor, possibly by use of more complete conveyor systems.

If the piles are sprinkled this process will only be required during dry weather or when high drying winds prevail in the summer time. At such time an abundant supply of water should be used. In the majority of mills pumps and pipes are already being installed or are under consideration for fire protection, which will also serve for sprinkling.

In nearly every case centrifugal fire pumps from 1,000 to 1,500 gallons capacity are advisable. These, of course, will be found more economical than steam pumps and can be throttled down so as to deliver the required amount of water. It will probably be found more economical generally to use them in this manner than to install smaller pumps for the length of time the sprinkling will be required.

A number of experiments have been undertaken, particularly from the standpoint of wood preservation by means of water. While this is familiar enough to everybody, it has not been used practically as a means of protecting pulpwood and groundwood pulp from rotting, therefore exact figures as to the limiting amounts are not available.

Fires in which there was Loss of Life.

These notes are intended to point out conditions under which loss of life occurred, that they may be known and guarded against.

H-16089. Woodworking Plant. This fire started in a dirty fly wheel pit in the engine room from an unknown cause just after plant had been shut down for the night. The engineer tried to put out the fire with a bucket of water; failing, he gave the alarm. The rapid spread of fire caused a panic. There were no fire escapes. Those who escaped jumped from the upper windows to the roofs of buildings below. Of the thirty-six men in the building, six lost their lives. The building was a total loss. **This loss of life is due primarily to uncleanliness, rubbish in the fly wheel pit.**

H-16074. Mercantile. Several large business houses were burned out with a loss of $75,000 in a fire which supposedly started from a gas stove. Two firemen were found dead the next morning.

H-15958. Garage. A boy, carrying an ordinary lantern, was filling the tank of an automobile inside the garage, using a five-gallon can. He overturned the lantern, igniting gasoline carelessly spilt on the running board. The explosion blew the boy outside of the garage, his clothes aflame. The garage was a total loss and the boy was fatally burned.

H-15732. Oil Refinery. A tank car of casing head gasoline without proper vents had been left standing in the hot sun. Internal pressure due to evaporation blew off the dome head cover while employee was trying to relieve pressure. Gasoline vapor travelled 200 feet to a forge fire, ignited, and flashed back to the tank, causing an explosion. One man was burned to death and two seriously burned. Loss, $7,000. **No open flames should be allowed in or near oil refinery.**

H-15754. Celluloid Works. Failure to open the electric switch shutting off the current when repairing an electric drying machine resulted in the death of a woman operative. Actual fire loss small. **Carelessness is the prevalent cause of loss of life and property.**

H-15897. Packing Plant. After fire was practically under control, two ammonia tanks used in the refrigerating system of the plant exploded, killing two men, injuring five others, and doing considerable damage to surrounding buildings. Ammonia containers or drums should be kept in dry, cool places, and where they are not likely to be exposed to fire. When under compression a slight rise in temperature causes a large increase in pressure, which readily occasions a violent explosion.

H-14420. Jewelry Factory. The building was five stories high, of brick construction, and located in down-town New York. It was leased for offices and jewelry manufacturing. There were wooden partitions throughout. Roof, board on joist, covered with composition tar paper; skylights, wired glass on metal frames; ceilings, sheathed with wood, except metal on first floor; open stairway. Fire started in a wooden closet used for the storage of waste paper and floor sweepings, under stairway leading to the fourth floor. Employee discovered fire at start, but was unable to extinguish it, as the two pails, the only fire protection available, were empty. The fire spread rapidly up the unprotected stairway and exterior unprotected windows to the top floor. The stairway and fire escape were both cut off by the flames. Five persons lost their lives. The upper floors were burned out, the lower floor suffered smoke and water damage. **Rubbish and waste material should never be stored under stairways. Fire extinguishing apparatus should always be kept in readiness for instant use, and should be inspected regularly.**

H-15859. Oil Tank Ship. An explosion occurred in a tank on board a steamship utilized for the transportation of gasoline and naphtha. The top of the tank and its lid, about four and one-half inches square, formed a portion of the upper deck, and was enclosed

with a metal housing about twenty-five feet square and eight feet high. Several iron workers were employed to drill holes in the top of the tank so that brackets might be attached for holding a walk across the top of the tank.

After the seamen were asleep, a terrific explosion occurred, forcing up the lid. Six men sleeping near the tank were instantly killed. No fire followed the flash. It is believed that the tank had not been thoroughly steamed out, and still contained gasoline vapor. How ignition took place is not known. **Many explosions have occurred in supposedly empty gasoline tanks from vapors still retained by the tank. Tanks which have been used for storage of gasoline or similar liquids should be thoroughly ventilated and steamed out.**

H-15932. Gasoline Storage. While filling the supply tank the man in charge allowed it to overflow. The gasoline ran down on an electric motor and ignited. The entire building burned to the ground, and the man himself died later from burns sustained.

H-14346. Apartment House. With a good start, the flames melted the lead connections of the tin gas meters in the basement, igniting the gas as it escaped. The fire spread rapidly to the upper floors through the light wells and open stairways. The gas cut-off valve was so concealed and obstructed by trash that the entire building was a seething furnace before it could be located. One old lady lost her life, thirty persons were injured, and a property loss of $150,000 resulted.

The use of the old style tin gas meter with lead connections has long since been condemned by the National Fire Protection Association as extremely hazardous.

H-16014. Hotel. Someone dropped a lighted cigarette or match into a metal receptacle filled with paper and rubbish, and placed in the service stairway by tenants. An elderly lady and gentleman both lost their lives. Tight metal covers should be provided for rubbish receptacles; they should never be kept in stairways.

H-15664. Mercantile. Fire occurred during the noon hour in the five-story building occupied by dealers in second-hand bagging. The firemen found the fire on the third floor, but were unable to get further than the head of the stairway. Several streams were used from that point; other streams were sent in through the windows from the ground. The fire had been burning only about thirty minutes when, without the slightest warning, the whole interior collapsed, the walls falling in a heap and burying a number of firemen in the debris. Some, seriously injured, were extricated alive; six others, after difficult search, were taken out dead. Overloading of the floors was given as the cause of the collapse.

H-15950. Lumber Yard. Acetylene tanks in the engine room of the planing mill exploded while the employees were trying to start the gas engine in the morning. Natural gas was used regularly for fuel, but acetylene was used for starting the engine. Three men were

injured; one of them died later. The fire was insignificant. **Acetylene under compression is very hazardous, and extreme care should be used in its handling and storage.**

H-15968. Glass Works. Fire started in the boiler room of the plant where two employees were repairing the oil piping, which at this point ran across the boilers. In some unexplained way the pipe broke; the heated oil was ignited by a gas jet attached to the brickwork of the boiler. The flame from the burning oil enveloped the two men, killing both. The fire was confined to the boiler house proper.

H-15940. Motion Picture Theatre. Fire originated in films carelessly left beside the exit ladder from the operator's booth. The operator and his assistant were both trapped in the booth. Actual fire was small. **Too great care cannot be exercised in the handling and storage of nitro-cellulose film.**

H-26008. Rubber Works. An explosion in the spreader room was caused by a spark from a small single-phase motor on a sewing machine, which ignited an accumulation of naphtha vapor. The fire spread so rapidly over rolls of fabric that it had passed through to the adjoining section before the automatic fire doors operated. Two workmen lost their lives; the loss on the fabrics was $30,000. No damage to the building.

The chief hazard in this industry is found in the use of naphtha and similar solvents. These should be kept well away from all machinery, and kept only in metal covered containers. Only non-sparking motors should be used.

Fire Causes.

The fires here given are selected to illustrate defects either of construction or superintendence in the classes of property indicated.

Boilers, Furnaces and Ovens.

S-23247. Foundry. Fire occurred on the second floor, and was caused by using the core oven immediately after a new floor had been laid. The wet fire clay cracked and ignited the wood floor under the oven. Fire was discovered and extinguished before sprinklers operated.

S-23728. Woodworker. The ceiling of boiler room was about four feet above the top of the boilers, and was covered with sheet-metal nailed to the joists. In the room above pipes were used to convey light wood refuse to the boiler room and shavings' vault. Dust worked down through the floor in small quantities and lodged on the sheet-metal ceiling, where it was ignited from the heat below. The watchman heard the sprinkler alarm, and located the fire when

it had just broken through the floor. Instead of using an extinguisher, he notified the foreman by telephone. In the meantime three sprinklers opened and completely extinguished the fire. Water damaged the main belt from the engine to the factory, which necessitated a shut-down of a week while belt was being dried out.

H-14093. Aeroplane Factory. Heat from a hot-air furnace was conducted through three inches of concrete, setting fire to the wood planking beneath.

H-15461. Metal Worker. Fire was caused by an overheated, fuel oil burning, hardening furnace which ignited woodwork nearby in spite of the asbestos covering. The fire spread rapidly throughout the plant, compelling several girls to jump from second story windows.

H-23514. Metal Worker. The floor under the gas-heated drying oven was of 3-inch plank with top flooring, on light timbers. The under side was sheathed with wire lath and plaster, and on the top side was an overlay of a 2-inch asbestos compound block. The oven stands on 3-inch legs, and is usually maintained at a heat of 350° F. Apparently the heat penetrated through the asbestos block overlay and ignited the floor. A hole over a foot square was burned in the floor, indicating a smouldering fire of some duration.

H-13628. Metal Worker. The iron solder melting pot was heated by a wood fire placed underneath the pot on its brick and cement base. The heat penetrated through the brick and cement base, carbonizing the plank floor beneath. When finally discovered, the fire had been smouldering for some time.

S-23046. Coffee and Spice Mill. A pile of hot coals were left on the concrete floor overnight. Heat was conducted through the 4-inch concrete floor to the wood floor beneath. Smoke was discovered by the watchman about three o'clock in the morning. The fire was confined to its point of origin, and easily extinguished with a small hose.

Construction.

S-23627. Knitting Mill. This is a typical "Cohoes" mill, with the carding and spinning rooms on the upper floors and with the finishing and stockrooms on the lower floors. The floors are not waterproofed. Fire was discovered about midnight at the feeding end of a carding machine. The fire communicated rapidly to neighboring machines until checked by the opening of six sprinkler heads. The firemen extinguished the fire with three hose lines from the city hydrants. The loss in the card room on the third floor was small, confined mainly to the feeds. The two lower floors suffered a heavy water damage, the water from the sprinklers having run through the non-watertight floors and soaked the stock below.

H-15486. Junk Shop. Fire was caused by spontaneous ignition of damp and oily burlap bags stored in large numbers in the shop.

The building was a one-story brick structure with a wood truss roof and corrugated iron roof covering. There were no fire walls, the entire building being one room. An outsider discovered the fire and summoned the fire department. Shortly after their arrival the roof fell in, because there was too great a spread for a wood truss roof without supporting columns in the center of the building. Large loss, $42,000.

H-15406. Motion Picture Theatre. Fire supposed to have started in a non-standard booth spread rapidly because of the inferior construction of the theatre, communicating to adjoining exposed buildings. The town was entirely without fire protection. The fire finally burned itself out. Loss, $83,000.

Unprotected Openings.

S-25247. Mattress Factory. Fire started in cotton sweeping machine on the first floor and spread through belt openings to the third floor. Forty sprinkler heads opened and aided by two hose streams extinguished the fire with a moderate loss.

S-24594. Shoddy Mill. Fire occurred in the picker room in the first story, and was caused by foreign substance passing through picker. This picker discharges into a small wood frame metal-lined room. The blazing stock was blown into this room, opening one sprinkler head in that room and two outside over the picker, which extinguished the fire. Sprinklers were allowed to operate about ten minutes, and were then shut off. While employees were obtaining new heads to replace those fused in picker room, fire broke out in the floor directly above. The fire had spread to the second floor through several belt holes, igniting jute and lint on the floor. No doubt the sprinklers on the second floor fused promptly, but as the valve had already been closed after the fire was under control in the first story, no water was available for the second outbreak. Twenty-one heads fused on the second floor where two or three would have been sufficient had water been on the system. **When for any reason it is necessary to shut off the water, a man should always be stationed at the control valve until the sprinkler system is again in service.**

H-14286. Hotel. Sparks from an electric motor in the basement caused the fire, which spread quickly to the upper floors of the hotel through an open elevator shaft and a light well or court. Efficient work by the fire department confined the fire to the northwest wing of the building. The loss on the building and contents was $80,000.

H-14921. Mercantile. The fire started in the basement at the base of an open frame elevator shaft, and was first discovered when a smoke explosion forced out the large plate-glass show windows on the front of the building. The flames spread so rapidly up through the building via the open elevator shaft that the fire was soon beyond control. Several firemen working on a fire escape were severely injured when the roof fell in, pushing out a section of the third story

wall. The building and contents were practically a total loss. Wired-glass windows were effective in protecting exposed windows.

H-14926. Public School. Fire occurred about 10:30 p. m. in the basement near one of the hot-air furnaces, and apparently worked its way along the ceiling until it reached the center of the building, then up a wood partition to the roof. This partition separated the hall from the class rooms, and had a four-inch air space between the outer and inner walls. That this air space acted as a flue for conveying the fire from the basement to the roof seems certain, because no evidence of the fire having burned through could be discovered on either the first or second floors, although the second floor and the roof suffered the greatest damage.

H-14391. Mercantile. Fire started from a 500-volt D. C. open motor which was suspended from the ceiling over an unprotected wood floor. Lightning had blown out the fuses, and these had been replaced. Apparently the motor had burned out, because while trying to start the motor the next morning enough sparks fell to ignite the wooden floor beneath. The first notification of fire was from the falling of the elevator automatic trap-doors. The gates of the elevator shaft were inside and held the traps open about eight inches, allowing the flames to pass through and reach the floors above by way of the shaft. **The gates should be placed far enough in front of the opening to allow the complete closing of the traps.**

Chimneys.

H-14913. Hotel. Fire caused by faulty chimney construction. Evidently while building the chimney 34 years ago the bricklayers found two two-by-four timbers in the way, and, instead of removing them, the bricklayers built them into the chimney. The chimney has been rebuilt properly.

Gasoline.

S-24623. Garage. Gasoline from an automobile truck had leaked through a 2-inch plank floor to the basement, where a steam boiler was located. While the car was being repaired an employee went downstairs to stoke the boiler. When he opened the door to the fire-box a flash occurred. Three sprinklers operated, extinguishing fire.

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